HAGIHARA

PROGRESS REPORT

Properties Occurrence and Management of Soils with Vesicular Surface Horizons

Contract No. 52500-CT5(N)

Between

USDI, Bureau of Land Management

and

Nevada Agricultural Experiment Station

By: Blackburn
Eckert, Jr.
Wood
Peterson

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INTRODUCTION

This cooperative research contract between the USDI - Bureau of Land Management and Nevada Agricultural Experiment Station was established July 1, 1974 to terminate June 30, 1976.

The study objective is to investigate the morphology and management of soils with a vesicular horizon.

Four seeding trial study sites have been established in northern Nevada (Fig. 1). These are located as follows: two sites at Coils Creek about 32 airline miles northwest of Eureka; one site at Panther Canyon approximately 30 miles south of Winnemucca; and one site at Paradise Valley about 40 miles north of Winnemucca. Three off-road vehicle study sites have been established (Fig. 1). One site is north of Halleleujah Junction, California approximately 25 airline miles northwest of Reno. The other two sites are located in southern Nevada, one site is just west of Crystal Springs (about 60 miles west of Caliente) and the other site about 10 miles south of Las Vegas.

The seeding trial sites are located in the big sagebrush vegetation type. Degree of vesicular horizon development is different at the four sites.

Off-road vehicle sites are located in the big sagebrush, blackbrush and creosote brush vegetation types. Likewise, vesicular horizon development varies among sites.

INTRODUCTION

This cooperative research contract between the BLM - Bureau of Land Management and Nevada Agricultural Experiment Station [illegible] 1976 to terminate June 30, 1979.

The study objective is to investigate the infiltration and erodibility of soils with a vesicular horizon.

Four seeding trial study sites have been established in northern Nevada (Fig. 1). These are located as follows: One site in [illegible] about 12 air line miles northeast of [illegible]; one site [illegible] approximately 30 miles south of Winnemucca; and one site in [illegible] about 40 miles north of Winnemucca. Three off-road vehicle study sites have been selected (Fig. 1); one site is south of [illegible], California approximately 25 air line miles northeast of [illegible]. The other two sites are located in southern Nevada; one site [illegible] about 80 miles west of [illegible] and the other site about 12 miles south of Las Vegas.

The seeding trial sites are located in [illegible] sagebrush vegetation type. Degree of vesicular horizon development is different at the four sites.

Off-road vehicle sites are located in the [illegible] creosote bush vegetation types. [illegible] vesicular horizon development varies among sites.

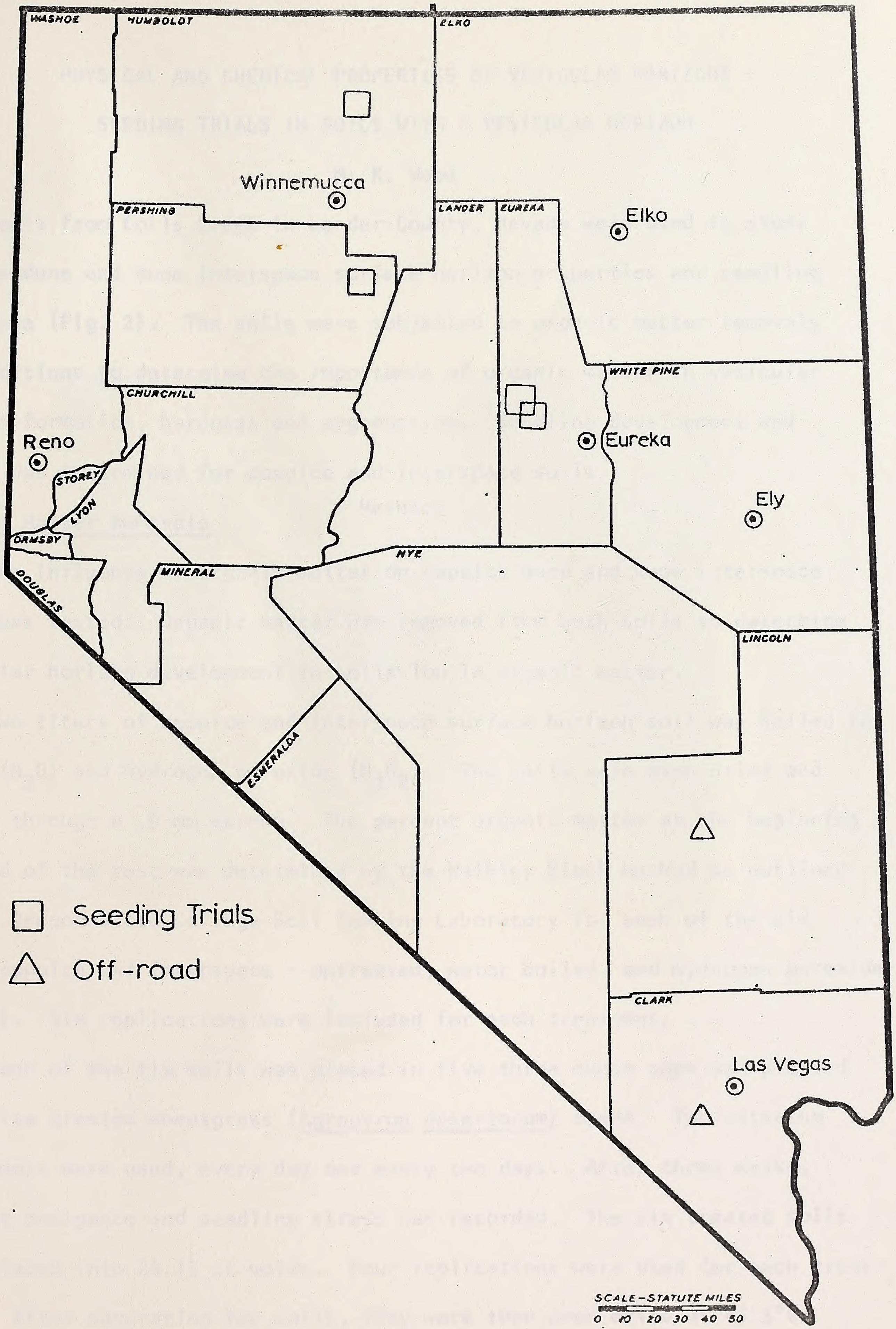


Figure 1. Location of seeding trials and off-road vehicle study sites.

PHYSICAL AND CHEMICAL PROPERTIES OF VESICULAR HORIZONS - SEEDING TRIALS IN SOILS WITH A VESICULAR HORIZON

M. K. Wood

Soils from Coils Creek in Lander County, Nevada were used to study coppice dune and dune interspace surface horizon properties and seedling emergence (Fig. 2). The soils were subjected to organic matter removals and additions to determine the importance of organic matter in vesicular horizon formation, hardness and aggregation. Seedling development and stress was determined for coppice and interspace soils.

Methods

Organic Matter Removals

The influence of organic matter on coppice dune and dune interspace soils was tested. Organic matter was removed from both soils to determine vesicular horizon development in soils low in organic matter.

Two liters of coppice and interspace surface horizon soil was boiled in water (H_2O) and hydrogen peroxide (H_2O_2). The soils were oven dried and sieved through a .5 mm screen. The percent organic matter at the beginning and end of the test was determined by the Walkley Black method as outlined by the Oregon State College Soil Testing Laboratory for each of the six soils(coppice and interspace - untreated, water boiled, and hydrogen peroxide boiled). Six replications were included for each treatment.

Each of the six soils was placed in five three ounce cups and planted with five crested wheatgrass (Agropyron desertorum) seeds. Two watering treatments were used, every day and every two days. After three weeks, percent emergence and seedling stress was recorded. The six treated soils were placed into 24.15 cc molds. Four replications were used for each treatment. After saturating the soils, they were then oven dried at 43.3°C overnight. The soil samples were removed from the molds and tested for

PHYSICAL AND CHEMICAL PROPERTIES OF VESICULAR HORIZONS

SEEDING TRIALS IN SOILS WITH A VESICULAR HORIZON

M. K. Wood

Soils from Coyote Creek in Harney County, Oregon were used to compare dune and dune interspace surface horizon properties and seedling emergence (Fig. 2). The soils were studied under [illegible] and conditions to determine the importance of organic matter in vesicular horizon formation, hardness and aggregation. Seedling emergence [illegible] was determined for sodic and intermediate soils.

Methods

Organic Matter Removal

The influence of organic matter on vesicular horizon [illegible] soils was tested. Organic matter was removed from [illegible] vesicular horizon development in soils [illegible].

Ten liters of sodic and intermediate surface horizon soil were treated with water (H_2O) and hydrogen peroxide (H_2O_2). The soils were [illegible] sieved through a 2 mm screen. The percent organic matter [illegible] and end of the test was determined by the Walkley-Black [illegible] by the Oregon State College Soil Testing Laboratory. [illegible] and intermediate [illegible] water [illegible] and [illegible] (control). Six replications were included for each treatment.

[illegible] of the six soils was placed in five flats [illegible] with [illegible] wheatgrass (Agropyron desertorum) seeds. Two watering treatments were used, every day and every two days. [illegible] percent emergence and seedling vigor was recorded. The [illegible] from 21 to 32 C [illegible]. Four replications were used for each treatment. After saturating the soils, they were [illegible] overnight. The soil samples were removed from the [illegible].

Figure 2. Coppice and interspace areas.

percent shrinkage, bulk density, and modulus of rupture (Reeve, 1965). The same tests were applied after the soils were saturated and dried two and four times.

Organic Matter Additions

The influence of adding organic matter to coppice and interspace soils was tested. Big sagebrush leaves and bunchgrass organic matter finely ground was added to coppice and interspace soils by 2% intervals up to 14% by weight. Six cm of soils was placed in 11.5 cm diameter x 8.0 cm cups. Each of the untreated and treated soil tests contained ten replications. The samples were saturated and air dried twice. Then percent organic matter, modulus of rupture, bulk density, and percent shrinkage measurements were obtained. The samples were divided into two water cycles (watered every two and four days and watered for one month). Each soil replication was planted at 2 cm depth with five crested wheatgrass seeds.

Seedling Stress During Emergence

Twenty four pots, 10 cm dia., were filled with six cm of coppice soil and 24 pots with six cm of interspace soil. Within each soil type, twelve pots were watered every three days, and twelve pots were watered every six days. Within each watering cycle six pots were planted with ten crested wheatgrass seeds and six pots with squirreltail (*Sitanion hystrix*) seeds. All seeds were planted two cm deep. The pots were randomly placed on a greenhouse bench.

After three weeks, total emergence was recorded (Fig. 3). Each seed and seedling was then examined and given a stress development rating. The stress rating is as follows:

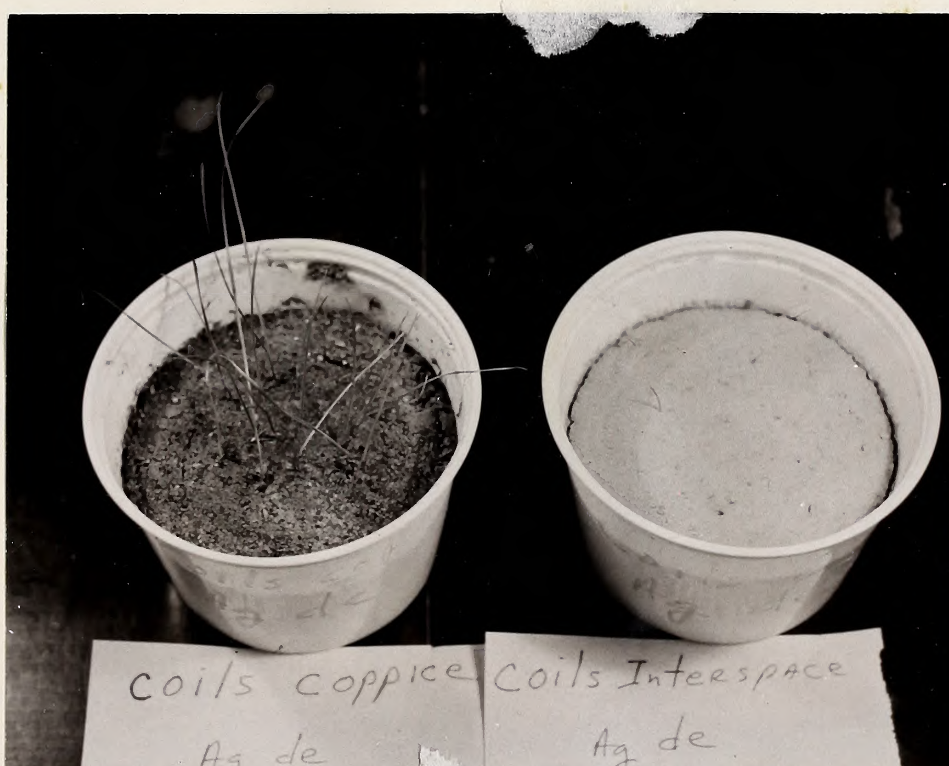


Figure 3. Emergence of crested wheatgrass in coppice (left) and interspace (right) soil. Note the low seedling emergence in interspace soil.

1. No visual stress - Root and coleoptile development normal.
2. Slight stress - Seedling emerged but with slightly wavey roots or coleoptile.
3. Moderate stress - Elongation of roots and coleoptile but with wavey stress signs.
4. Heavy stress - Modified roots or coleoptile elongation greater than 1 mm.
5. Extreme stress - Germination started but stopped immediately. Elongation less than 1 mm.
6. Failure - Seed did not germinate.

Total emergence was compared with a factorial (2 x 2) analysis, as were stress and development.

Field Trials

Four study sites were selected. Two are in the Coils Creek Watershed in Eureka County, one is near Paradise Valley in Humboldt County, and one is in Panther Canyon in Pershing County (Fig. 4). Each site contains a one-half hectare enclosure. Within the enclosure is a 55 m x 107 m plot. The plot is divided into forty 6 x 6 subplots (Fig. 5). Twenty of the subplots were deep plowed and twenty were not plowed (Fig. 6). In the plowed and unplowed subplots, five plots were broadcast seeded with cow trampling simulation, five were broadcast with no cow trampling, five were deep furrow drilled, and five were standard drilled (Fig. 7). Four species were planted in each subplot. Species seeded were crested wheatgrass, squirreltail, Thurber's needlegrass (*Stipa thurberiana*), and four-winged salt bush (*Atriplex canescens*).

1. No visual stress - [illegible] and uniformly green.

2. Slight stress - Seedling elongated and [illegible] chlorotic.

3. Moderate stress - Elongation of roots and shoots [illegible] slight.

4. Heavy stress - Retarded roots [illegible]

5. Severe stress - Germination [illegible]

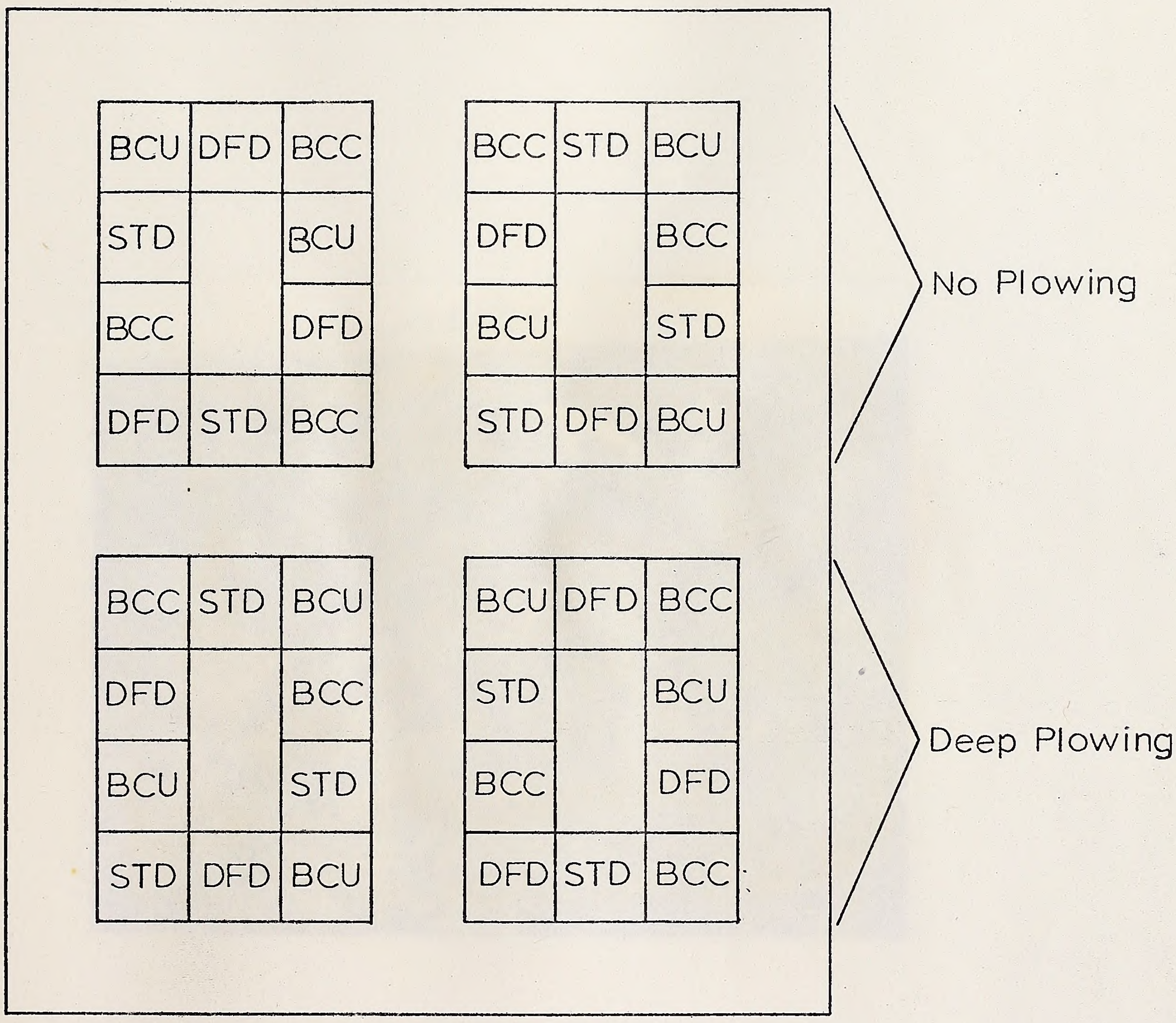
6. Lethal - Seed did not germinate.

Table [illegible] presents the [illegible] sites and treatments.

Field Trials

[illegible] in Eureka County, [illegible] fall [illegible] plot is divided into [illegible] were [illegible] and [illegible] were not [illegible] (Fig. [illegible]) [illegible] used [illegible] Five plots [illegible] simulation [illegible] were broadcast [illegible] Further [illegible] five were [illegible] (Fig. [illegible]) [illegible] planted [illegible] were sampled. Species [illegible] ([illegible]) [illegible]

Figure 4. Panther Canyon study site.



BCU - Broadcast seeding - no trampling simulation
BCC - Broadcast seeding - cow trampling simulation
STD - Standard Drill seeding
DFD - Deep Furrow Drill seeding

Figure 5. Plot diagram.

Figure 6. Deep furrow drill on deep plowed area, upper Coils Creek study site.

Figure 7. Broadcast (with and without cow trampling simulation) standard drill, and deep furrow drill treatments at lower Coils Creek study site.

The amount of precipitation is being recorded at each site. All treatments were conducted between October 12 - November 1, 1974. Treatments will be evaluated in April, 1975 (Fig. 8).

Results and Discussion

Organic Matter Removals

When coppice and interspace soils were boiled in water, a slight decrease in organic matter resulted. When boiled in hydrogen peroxide, a small amount of organic matter remained in each soil (Table 1).

Table 1. Percent organic matter in coppice and interspace soils that were untreated, boiled in water and in hydrogen peroxide.

Treatment	Mean % O.M.[1/]
Untreated Coppice	5.10
H_2O Boiled Coppice	4.63
H_2O_2 Boiled Coppice	1.14[a]
Untreated Interspace	1.31
H_2O Boiled Interspace	1.14[a]
H_2O_2 Boiled Interspace	1.09[a]

1/ Means with the same superscript are not significantly different at the .05 level of probability as determined by Duncan's Multiple Range Test.

When crested wheatgrass seeds were planted in untreated, H_2O boiled, and H_2O_2 boiled coppice and interspace soils, the percent emergence decreased with a decrease in organic matter (Fig. 9). Watering treatments also had a significant effect. Emergence in coppice soils was markedly higher than in interspace soils except for hydrogen peroxide treated soils that were watered every two days. Vesicular pore development and crust hardness are maximum

The amount of [illegible] is being [illegible] [illegible] [illegible] [illegible] [illegible] were conducted between December 12 - November [illegible] [illegible] [illegible] be evaluated in April, [illegible] (Fig. 2).

Results and Discussion

Organic Matter Removals

When coppice and interspace soils were boiled [illegible] [illegible] in organic matter resulted. [illegible] boiled [illegible] treatments [illegible] [illegible] of organic matter removed in each soil (Table 1).

Table 1. Percent organic matter in coppice and interspace soils [illegible] untreated, boiled in [illegible] [illegible] [illegible] [illegible]

[illegible]	Mean [illegible]
Untreated Coppice	[illegible]
H_2O Boiled Coppice	[illegible]
H_2O_2 Boiled Coppice	[illegible]
Untreated Interspace	[illegible]
H_2O Boiled Interspace	[illegible]
H_2O_2 Boiled Interspace	[illegible]

1/ Means with the same superscripts are not significantly different at the .05 level of probability as determined by Duncan's Multiple Range Test.

When [illegible] [illegible] seeds were planted in untreated, H_2O boiled and H_2O_2 boiled coppice and interspace soils, the percent emergence [illegible] with a decrease in organic matter (Fig. 3). Watering treatments were not [illegible] significant effects. Emergence in coppice soils was [illegible] higher than in interspace soils except for hydrogen peroxide treated soils that were watered every two days. [illegible] [illegible] more emergence and [illegible] [illegible] [illegible] [illegible]

Figure 8. Deep furrow drill treatment at Paradise Valley study site.

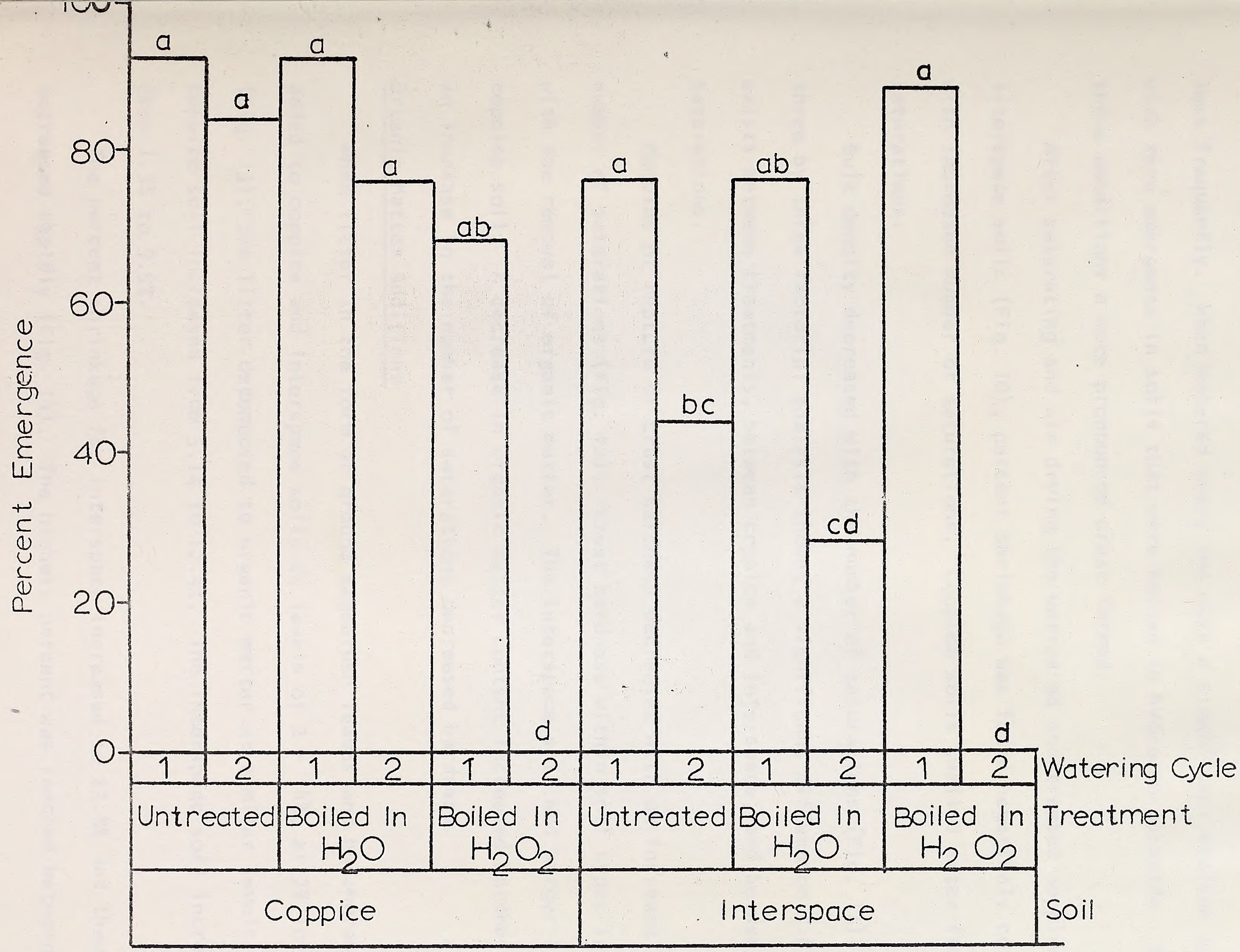


Figure 9. Percent emergence of crested wheatgrass planted in untreated, water boiled, and hydrogen peroxide boiled coppice and interspace soils. Means with the same superscript are not significantly different at the .05 level of probability.

at low organic matter content and low moisture content. Interspace soils watered every day had a higher seedling emergence than those soils watered less frequently. When watered every two days a significant decline resulted with zero emergence in soils that were boiled in hydrogen peroxide. Under these conditions a more pronounced crust formed.

After saturating and air drying the untreated and treated coppice and interspace soils (Fig. 10), percent shrinkage was found negatively correlated with increased number of saturations. Coppice soils swelled after four saturations.

Bulk density decreased with the number of saturations (Fig. 11). A three by three factorial analysis showed a significant difference (.05 level) exists between treatments, between coppice and interspace, and between saturations.

Modulus of rupture or crust hardness decreased with an increase in the number of saturations (Fig. 12). Crust hardness within soil types increased with the removal of organic matter. The interspace soil was harder than coppice soil. A decrease in organic matter content increased hardness, while an increase in the number of saturations decreased hardness.

Organic Matter Additions

When litter in the form of ground sagebrush leaves and bunchgrass was added to coppice and interspace soils at levels of 2 - 14%, at 2% intervals (Fig. 13), the litter decomposed to organic matter at similar levels. The coppice soil increased from 5.1% to 12.4%. The interspace soil increased from 1.3% to 9.9%.

The percent shrinkage for interspace increased to 22.8% and then decreased rapidly (Fig. 14). The highest percent was reached between five

at low organic matter content was the primary control. [illegible] watered every day had a higher [illegible] than [illegible] less frequently. When watered every two days a significant [illegible] with zero amendment in soils that were [illegible]. Under these conditions, a more pronounced crust formed.

After saturating and air drying the untreated [illegible] and interrange soils (Fig. 9C), percent shrinkage was found to increase with increased number of saturations. Coppice soils averaged [illegible] saturations.

Bulk density decreased with the number of saturations (Fig. 9D). A three by three factorial analysis showed a significant difference ($p < 0.05$) exists between treatments, between coppice and interrange, and between saturations.

Modulus of rupture of untreated soils increased with an increase in the number of saturations (Fig. 9E). [illegible] with the removal of organic matter. The [illegible] coppice soil. A decrease in organic carbon content increases [illegible] as increases in the number of saturations [illegible].

Organic Matter Additions

When 1152 g [illegible] was added to coppice and interrange soil, levels of [illegible] (Fig. 10), the higher carbon and [illegible] organic matter of [illegible] levels. The coppice soil increased from 6.74 to 15.9%. The interspace soil increased from 1.35 to 3.3%.

The percent shrinkage for interspace increased to [illegible] and then decreased rapidly (Fig. 10). The greatest percent [illegible]

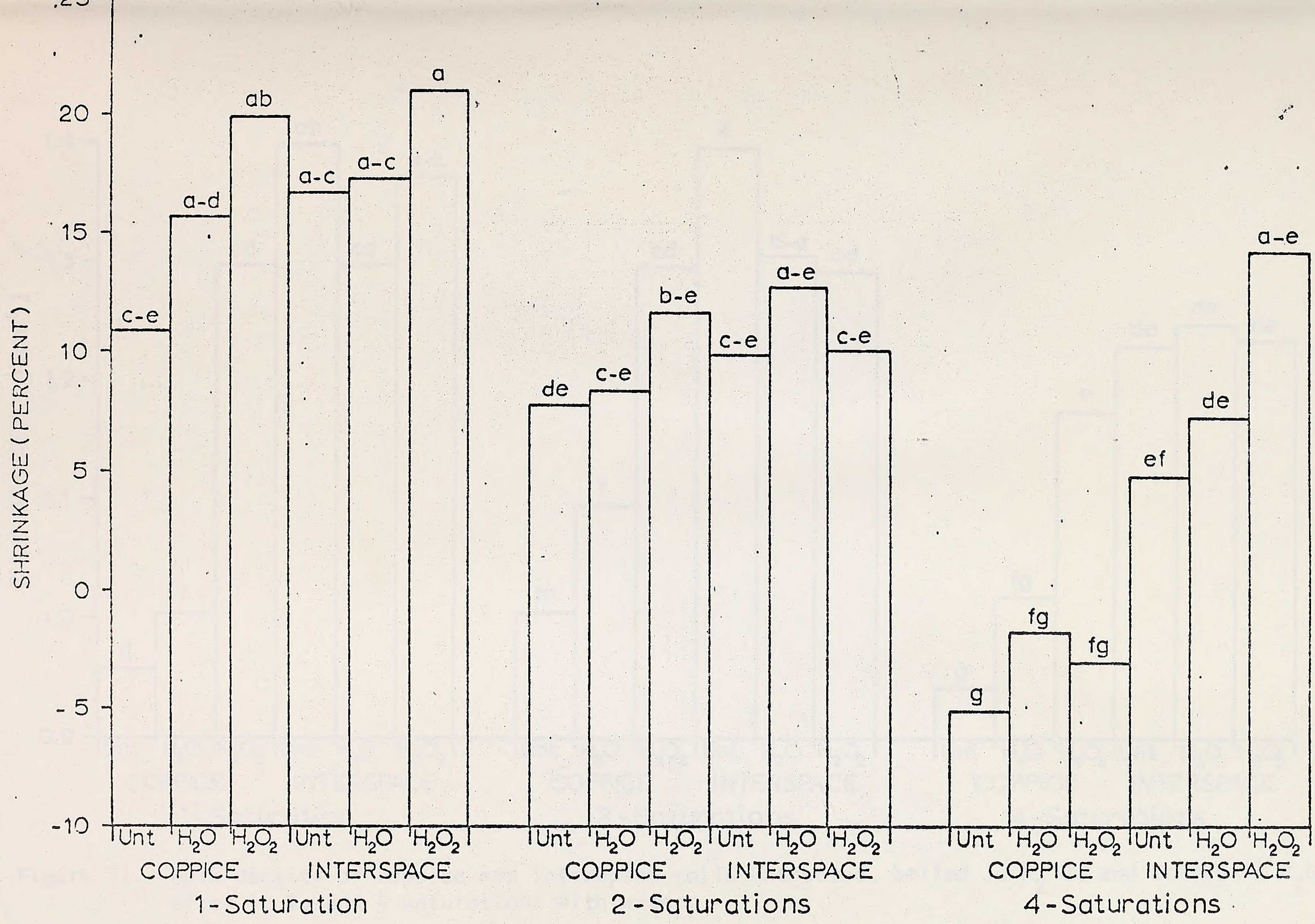


Figure 10. Percent shrinkage of coppice and interspace soils untreated, boiled in H_2O, and boiled in H_2O_2 after 1, 2, and 4 saturations with water.

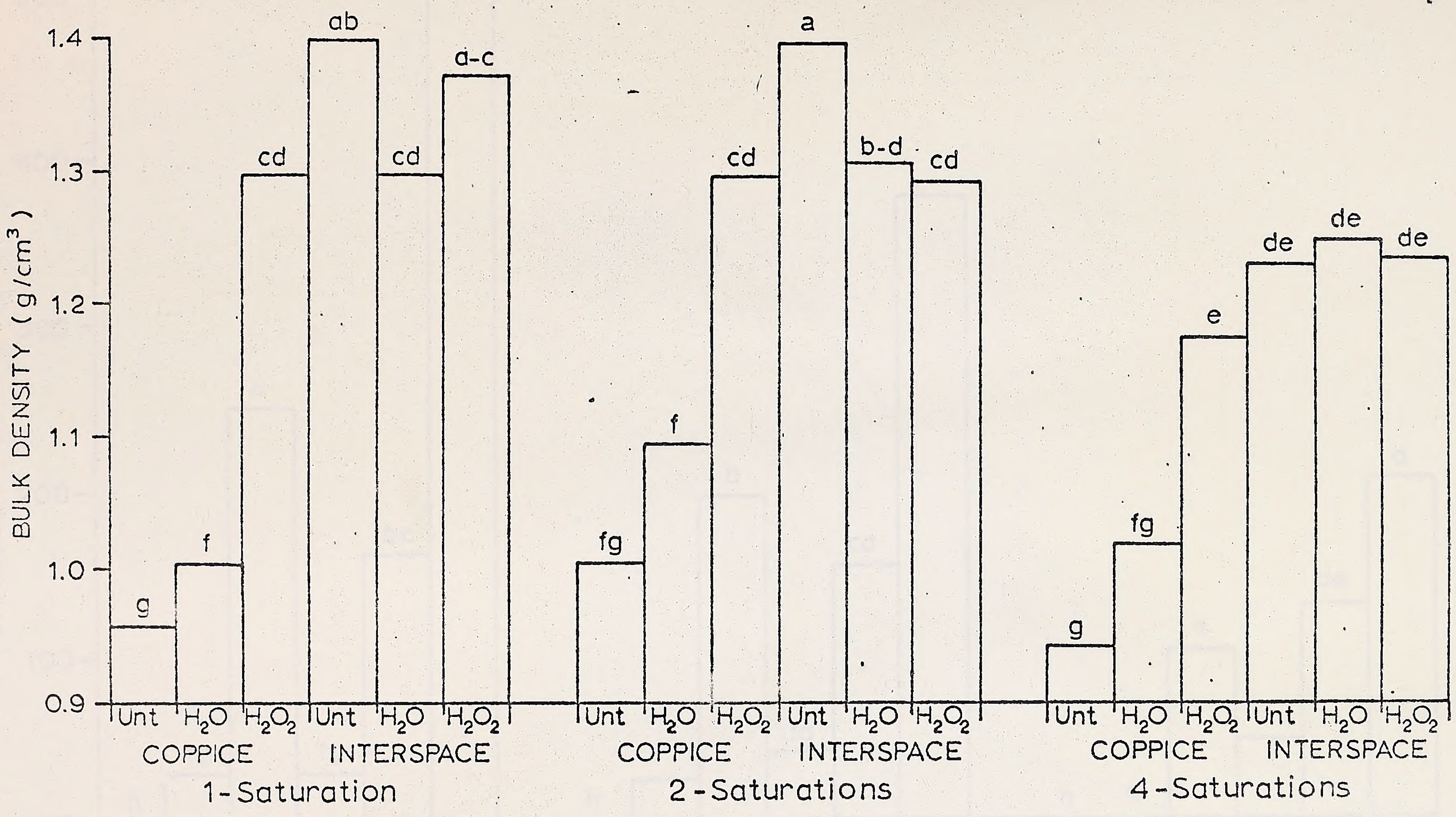


Figure 11. Bulk density of coppice and interspace soils untreated, boiled in H_2O, and boiled in H_2O_2 after 1, 2, and 4 saturations with water.

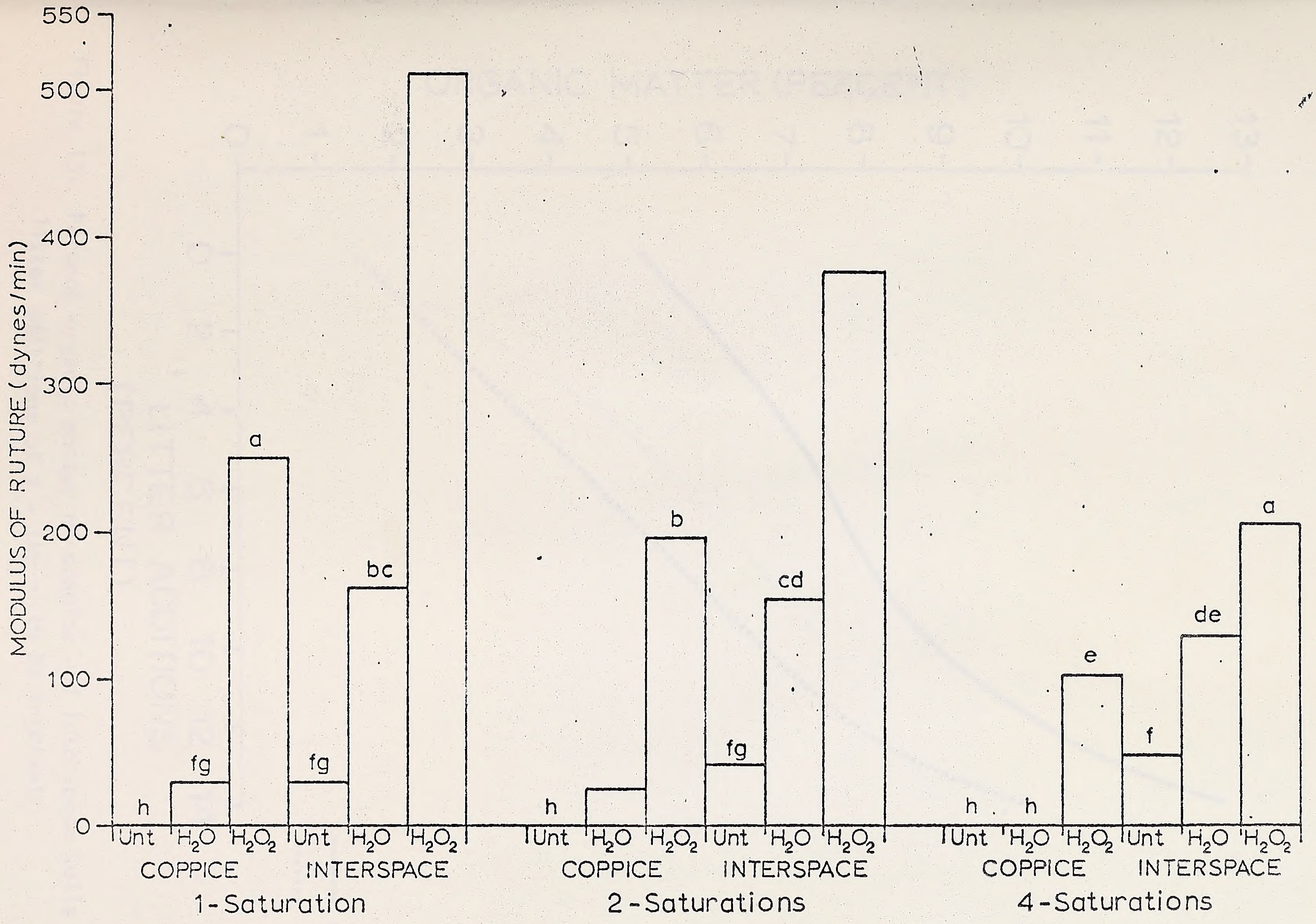


Figure 12. Modulus of rupture of coppice and interspace soils untreated, boiled in H_2O, boiled in H_2O_2 after 1, 2, and 4 saturations with water.

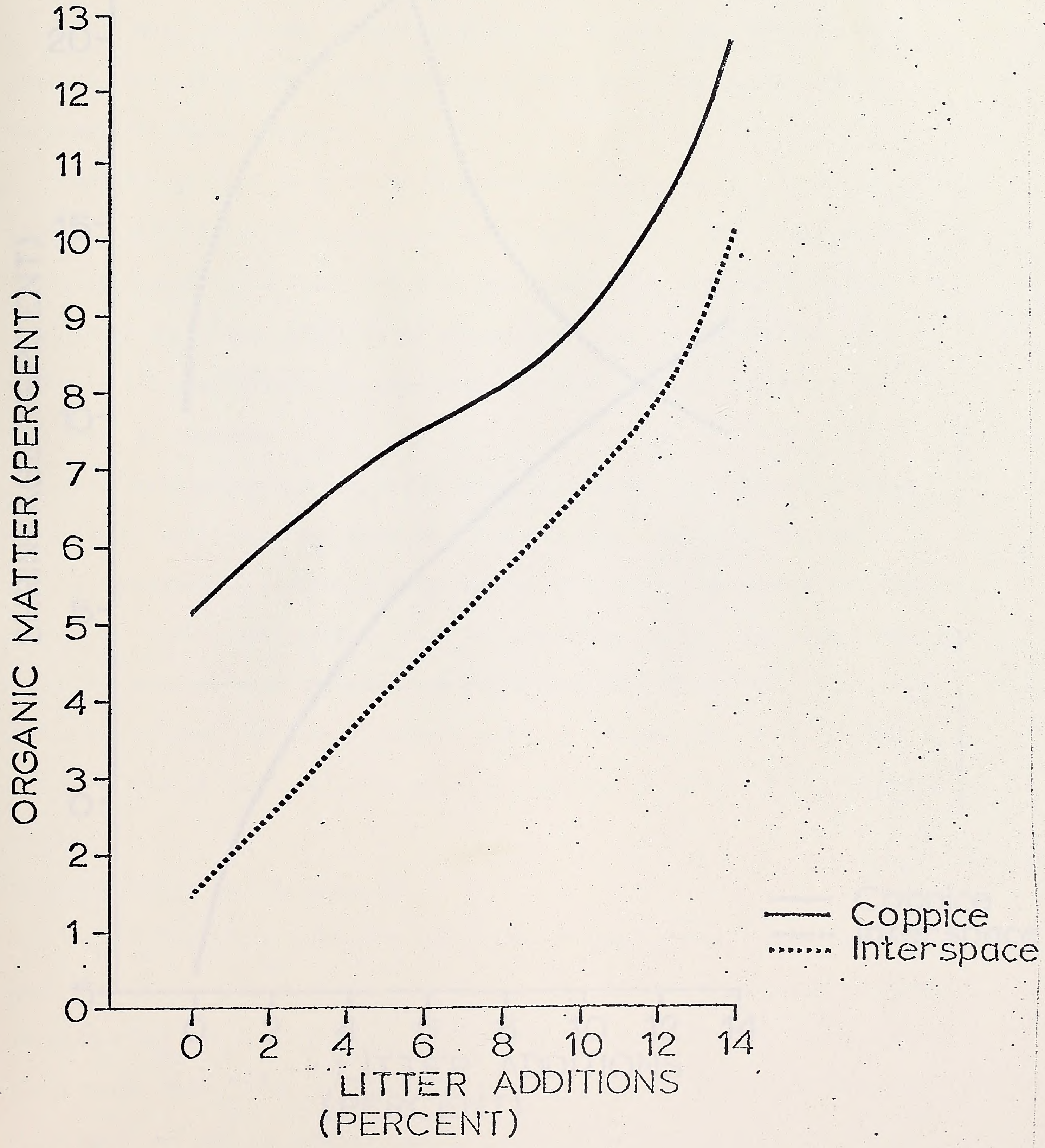


Figure 13. Percent organic matter of coppice and interspace soils with litter additions of 2 - 14% with 2% intervals.

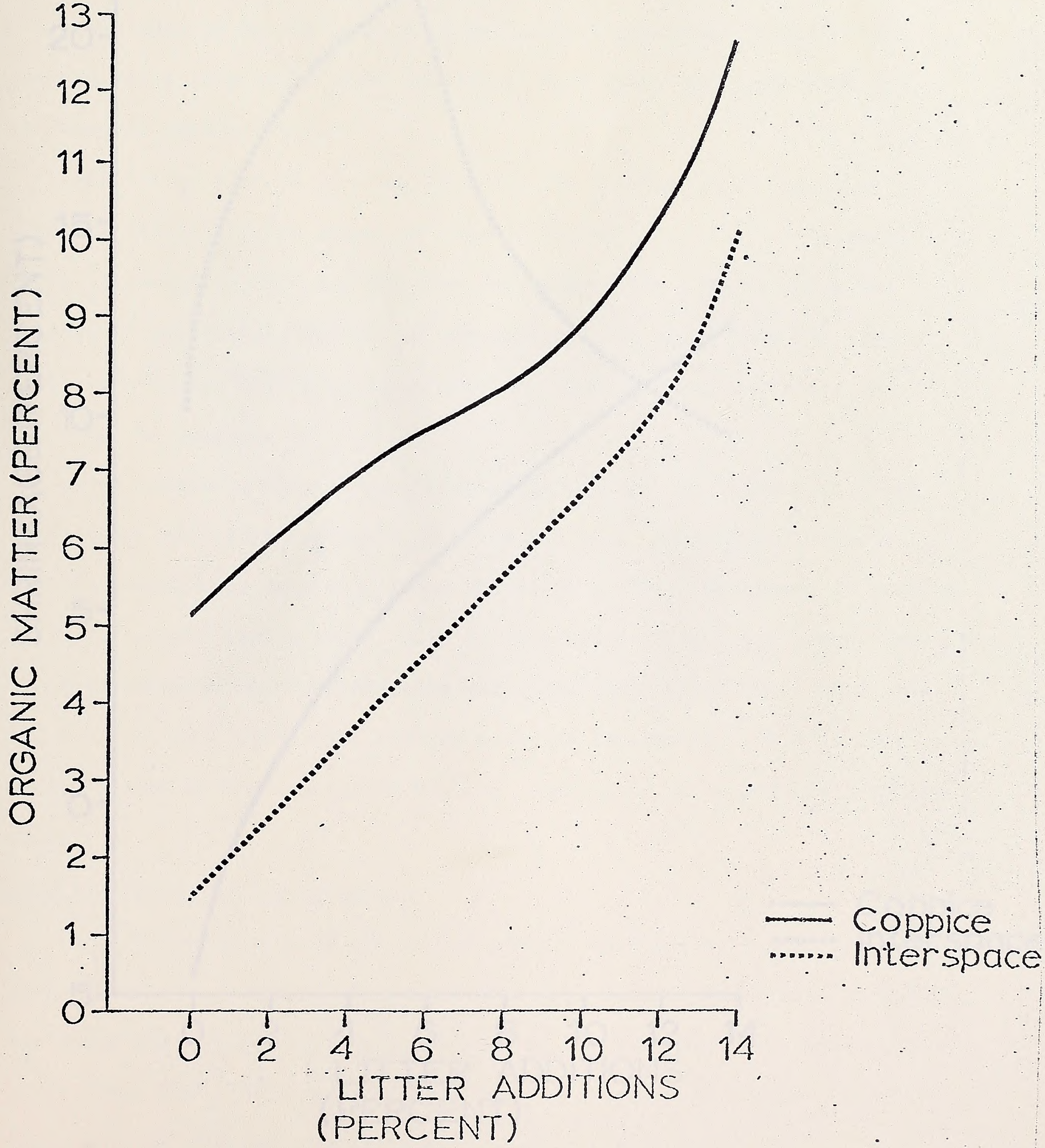


Figure 13. Percent organic matter of coppice and interspace soils with litter additions of 2 - 14% with 2% intervals.

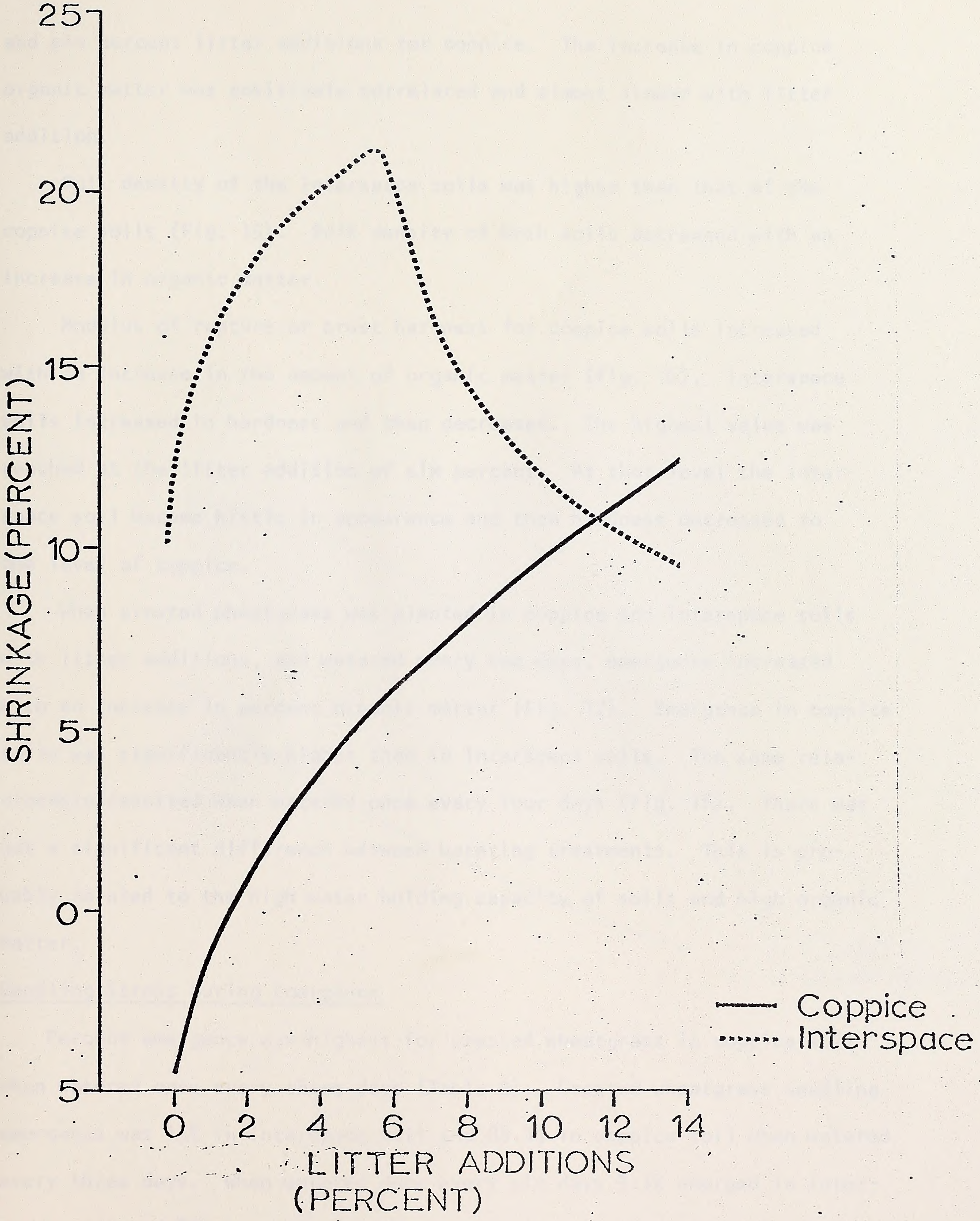


Figure 14. Percent shrinkage of coppice and interspace soils with litter additions of 2 - 14% with 2% intervals.

and six percent litter additions for coppice. The increase in coppice organic matter was positively correlated and almost linear with litter addition.

Bulk density of the interspace soils was higher than that of the coppice soils (Fig. 15). Bulk density of both soils decreased with an increase in organic matter.

Modulus of rupture or crust hardness for coppice soils increased with an increase in the amount of organic matter (Fig. 16). Interspace soils increased in hardness and then decreased. The highest value was reached at the litter addition of six percent. At that level the interspace soil became histic in appearance and then hardness decreased to the level of coppice.

When crested wheatgrass was planted in coppice and interspace soils with litter additions, and watered every two days, emergence increased with an increase in percent organic matter (Fig. 17). Emergence in coppice soils was significantly higher than in interspace soils. The same relationship resulted when watered once every four days (Fig. 18). There was not a significant difference between watering treatments. This is probably related to the high water holding capacity of soils and high organic matter.

<u>Seedling Stress During Emergence</u>

Percent emergence was highest for crested wheatgrass in coppice soil when watered once every three days (Table 2). Crested wheatgrass seedling emergence was 15% in interspace soil and 88.3% in coppice soil when watered every three days. When watered once every six days 3.3% emerged in interspace soil and 80% in coppice soil.

and six percent litter additions are combined. The increase in organic matter was primarily a result of high litter [illegible] additions.

Bulk density of the [illegible] compacted soils (Fig. 12). [illegible] increases in organic matter.

Modulus of rupture [illegible] with an increase in the amount of organic matter (Fig. 13). [illegible] soils increased [illegible] reduced at the [illegible] spray could reduce [illegible] the level of [illegible].

When [illegible] with litter additions [illegible] with an increase in the [illegible] organic matter (Fig. 14). [illegible] soils [illegible] tionship [illegible] not a significant [illegible] bably related to the [illegible] matter.

Seedling Survival [illegible]

Percent [illegible] when [illegible] every three days. [illegible] space [illegible]

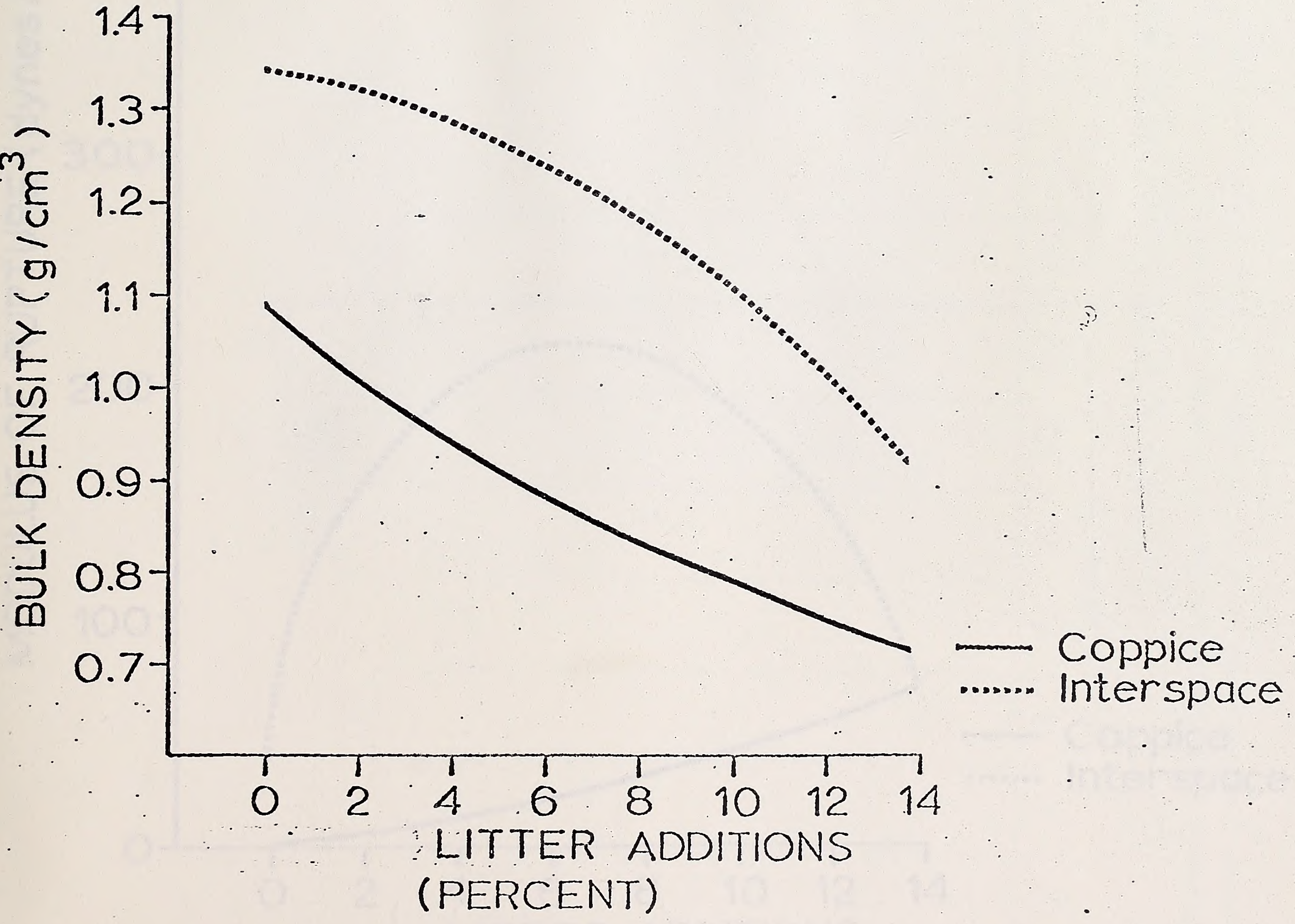


Figure 15. Bulk density of coppice and interspace soils with litter additions of 2 - 14% with 2% intervals.

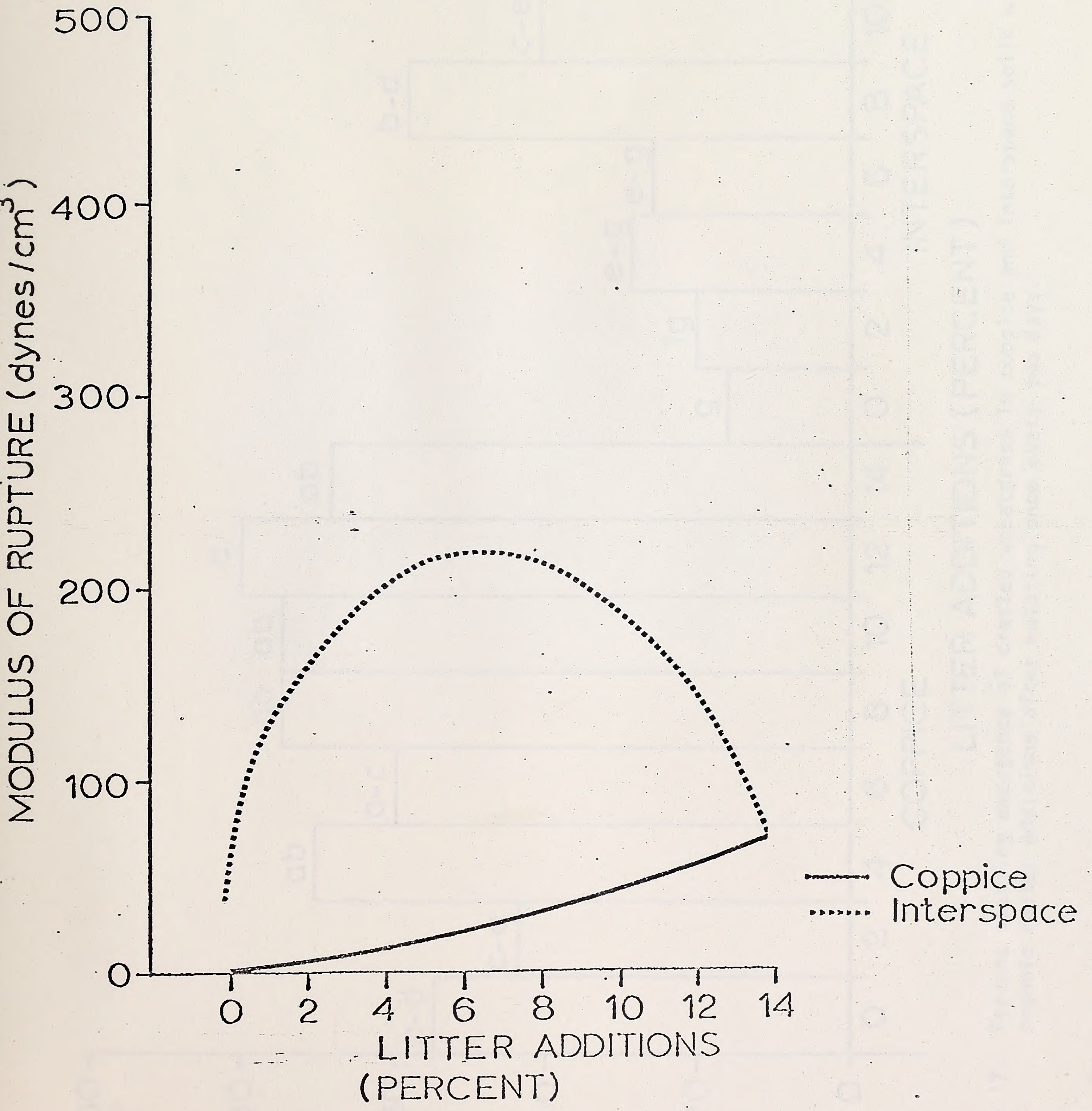


Figure 16, Modulus of rupture of coppice and interspace soils with litter additions of 2 - 14%.

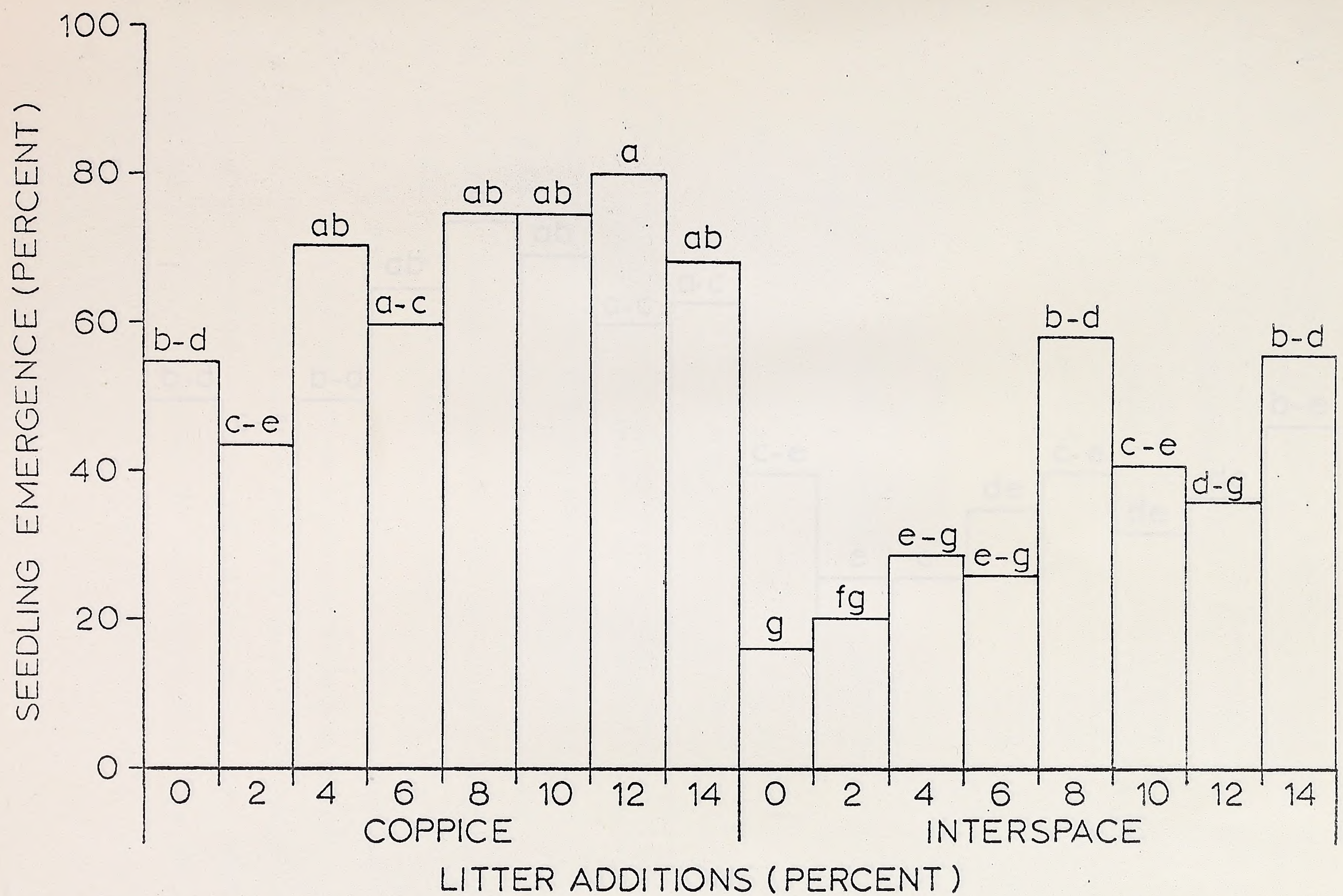


Figure 17. Percent seedling emergence of crested wheatgrass in coppice and interspace soils with organic matter additions after watering once every two days.

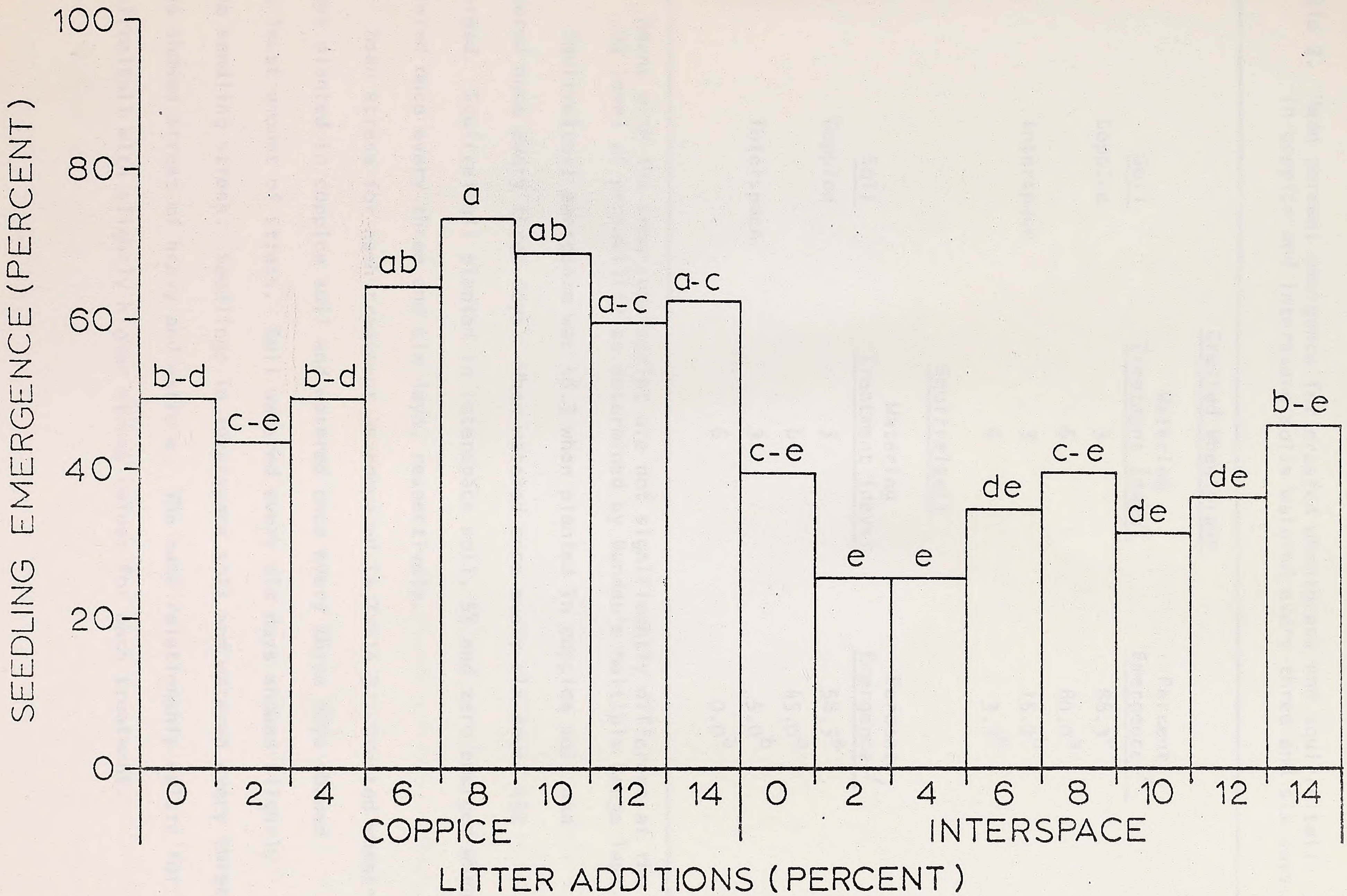


Figure 18. Percent seedling emergence of crested wheatgrass in coppice and interspace soils with organic matter additions after watering once every four days.

Table 2. Mean percent emergence for crested wheatgrass and squirreltail in coppice and interspace soils watered every three and six days.

Crested Wheatgrass

Soil	Watering Treatment (days)	Percent Emergence 1/
Coppice	3	88.3[a]
	6	80.0[a]
Interspace	3	15.0[b]
	6	3.3[b]

Squirreltail

Soil	Watering Treatment (days)	Percent Emergence 1/
Coppice	3	58.3[a]
	6	45.0[a]
Interspace	3	5.0[b]
	6	0.0[b]

1/ Means with the same superscript are not significantly different at the .05 level of probability as determined by Dundan's Multiple Range Test.

Squirreltail emergence was 58.3 when planted in coppice soil and watered once every three days. When watered once every six days, 45% emerged. Squirreltail planted in interspace soil, 5% and zero emerged when watered once every three and six days, respectively.

Mean stress for each treatment is compared in Table 3. Crested wheatgrass planted in coppice soil and watered once every three days showed the least amount of stress. Soil watered every six days showed slightly more seedling stress. Seedlings in interspace soil and watered every three days showed stress of heavy and extreme. The same relationship exists for squirreltail with slightly higher stress values for each treatment.

Table 3. Mean stress for crested wheatgrass and squirreltail in coppice and interspace soils watered every three and six days.

Crested Wheatgrass

Soil	Watering Treatment (days)	Stress Rating 1/
Coppice	3	1.57[a]
	6	1.85[a]
Interspace	3	3.83
	6	4.7

Squirreltail

Soil	Watering Treatment (days)	Stress Rating
Coppice	3	2.30[a]
	6	2.35[a]
Interspace	3	4.20
	6	5.60

1/ Means with the same superscript are not significantly different at the .05 level of probability.

Figs. 19, 20, 21 and 22 show the percent germination in each stress class for each soil type and watering treatment. Crested wheatgrass planted in coppice soil (Fig. 19) and watered every three days showed the following: 72% showed no stress, 18% showed slight stress, 3% showed moderate stress, and 7% did not germinate. Zero seedlings showed heavy or extreme stress. This was quite similar to watering every six days (Fig. 21) when 53, 27, 13, and 7% occurred with zero, slight and moderate stress and no germination, respectively. When planted in interspace soil and watered every three days, 1, 15, 32, 17, 20, and 15% showed zero, slight, moderate, heavy and extreme stress and no germination. Most (67%) of the seedlings showed moderate to heavy stress. Watering every six days, 5, 8, 8, 68, and 10% showed slight, moderate, heavy and extreme stress, and no germination, respectively.

Table 3. Mean stress for [illegible] and intermediate soils [illegible]

Soil	[illegible]	[illegible]
Complex	[illegible]	[illegible]
	[illegible]	[illegible]
Intermediate	[illegible]	[illegible]
	[illegible]	[illegible]

Soil	[illegible]	[illegible]
Complex	[illegible]	[illegible]
	[illegible]	[illegible]
Intermediate	[illegible]	[illegible]
	[illegible]	[illegible]

1/ Means with the same [illegible] are not [illegible] at the .05 level of probability.

Figs. 19, 20, 21 and 22 [illegible] class for each soil [illegible] In complex soil (Fig. 19) [illegible] 72% showed no stress, 18% [illegible] and 7% [illegible] This was quite similar [illegible] and 7% [illegible] respectively. [illegible] stress and no [illegible] heavy stress [illegible] moderate, heavy and [illegible]

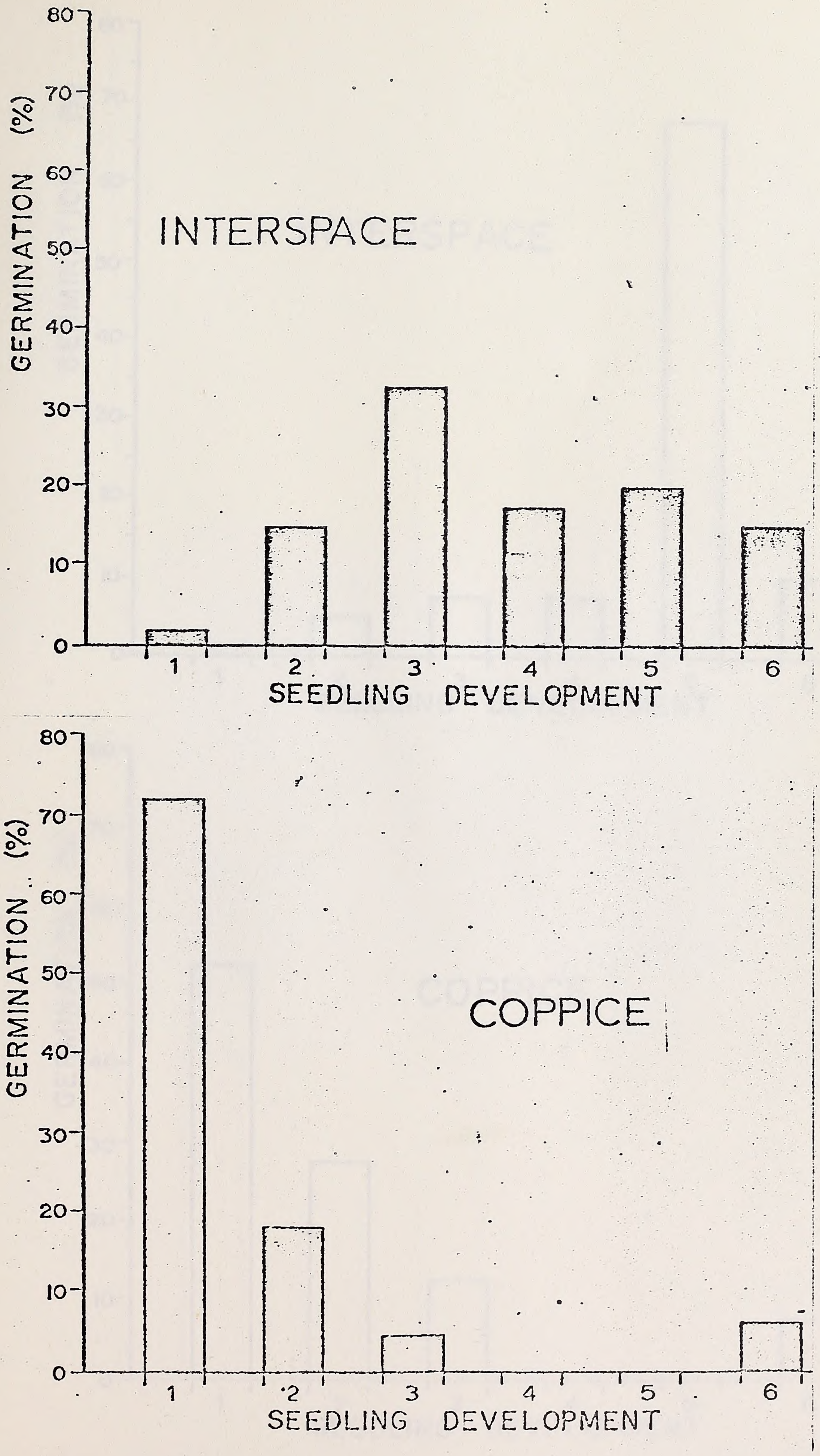


Figure 19. Seedling development of crested wheatgrass when planted in coppice and interspace soils with waterings once every three days.

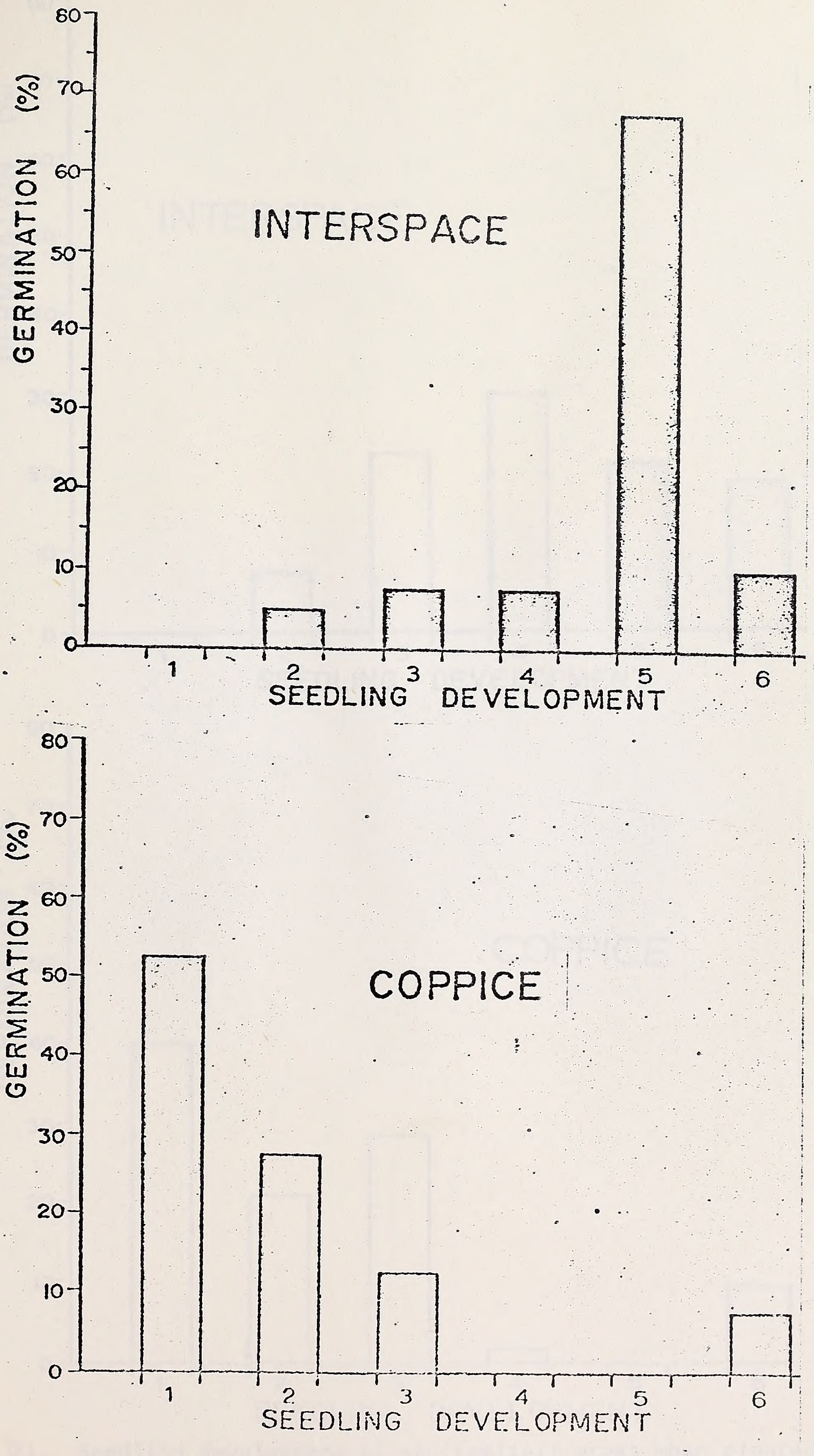


Figure 20. Seedling development of crested wheatgrass when planted in coppice and interspace soils with waterings once every six days.

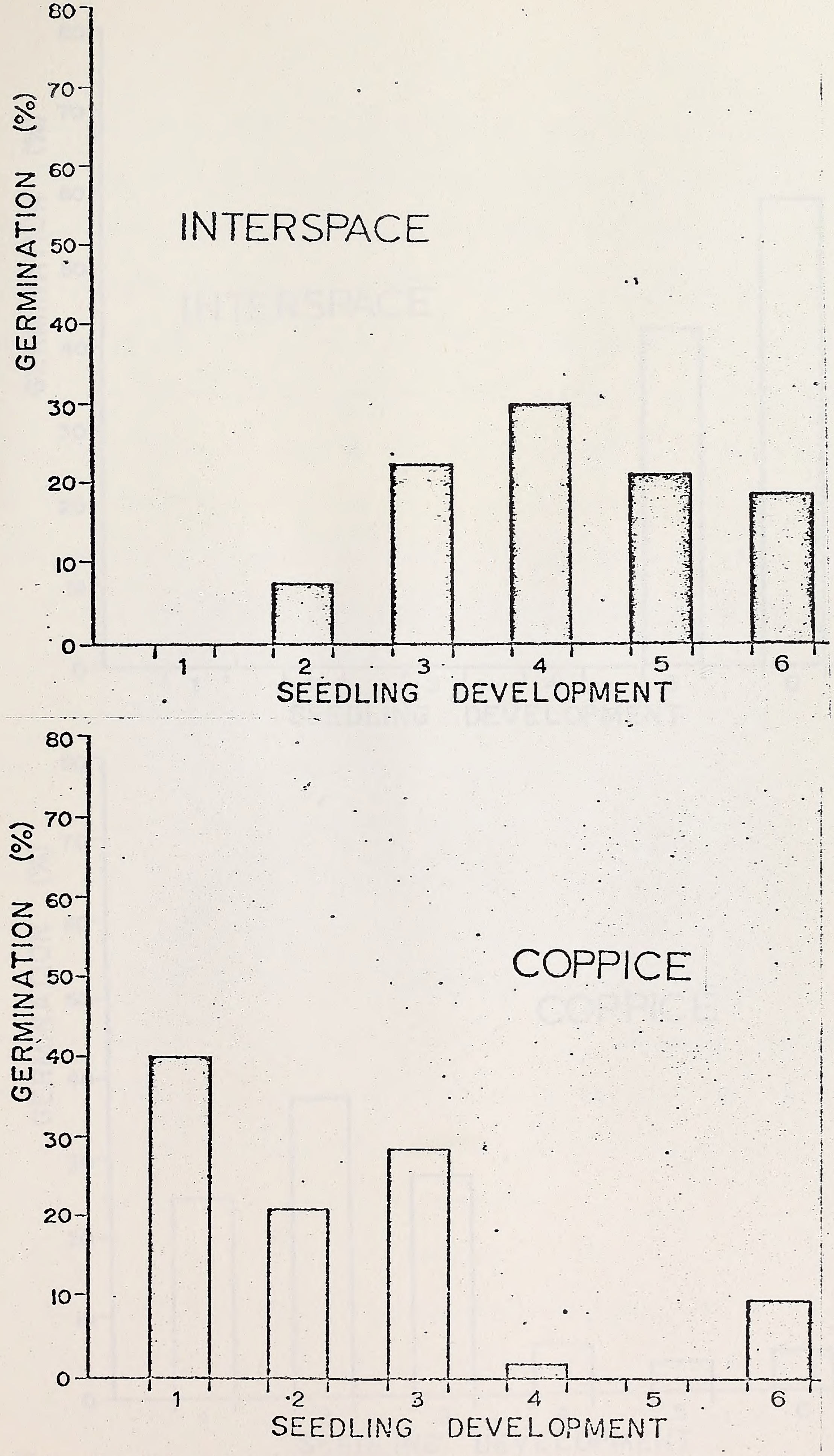


Figure 21. Seedling development of squirreltail grass when planted in coppice and interspace soils with waterings once every three days.

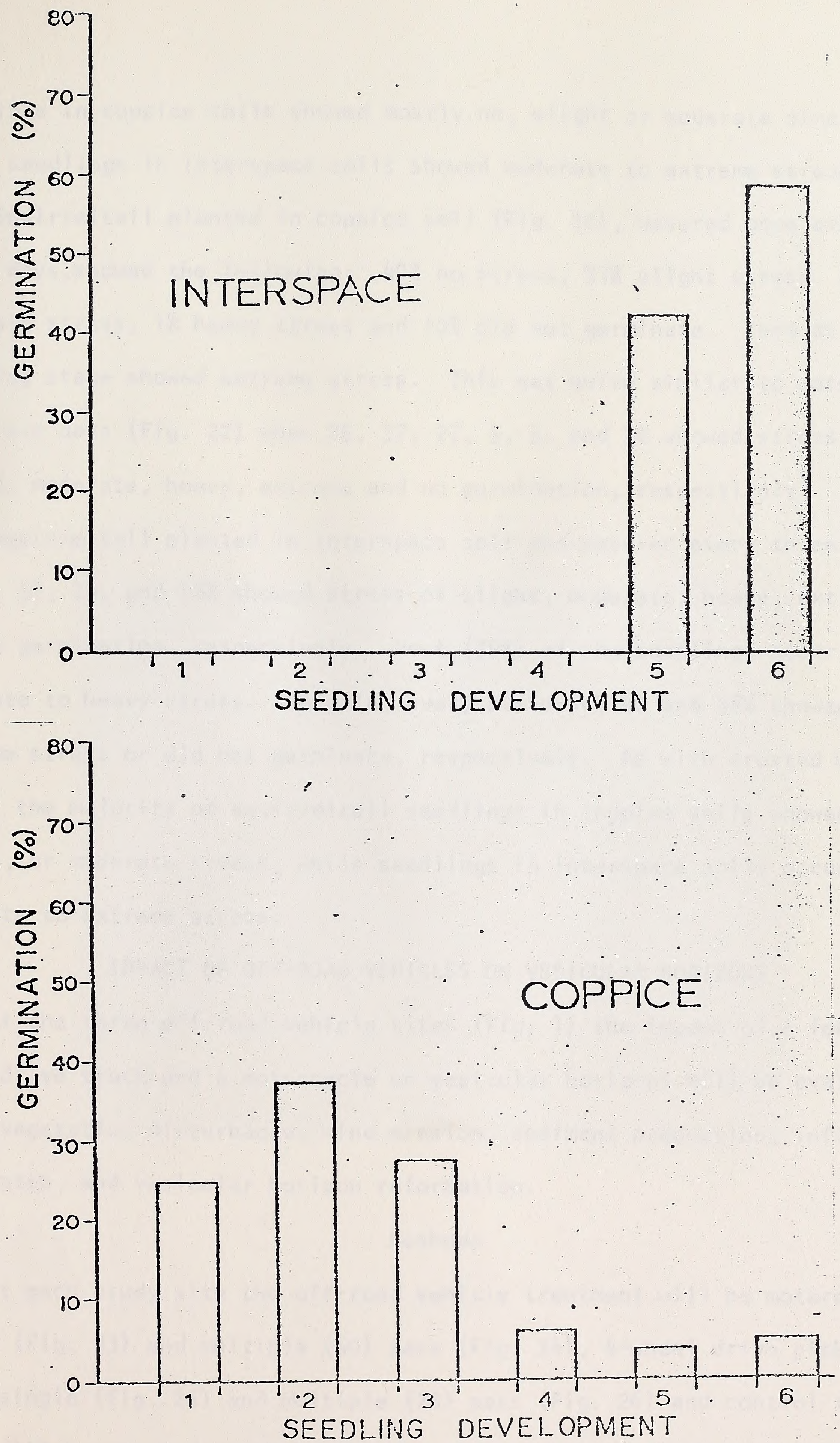


Figure 22. Seedling development of squirreltail grass when planted in coppice and interspace soils with waterings once every six days.

Seedlings in coppice soils showed mostly no, slight or moderate stress, while seedlings in interspace soils showed moderate to extreme stress.

Squirreltail planted in coppice soil (Fig. 20), watered once every three days,showed the following: 40% no stress, 21% slight stress, 28% moderate stress, 1% heavy stress and 10% did not germinate. Zero at the seedling stage showed extreme stress. This was quite similar to watering every six days (Fig. 22) when 25, 37, 27, 5, 3, and 3% showed stress of zero, slight, moderate, heavy, extreme and no germination, respectively.

Squirreltail planted in interspace soil and watered every three days, 7, 23, 30, 22, and 18% showed stress of slight, moderate, heavy, extreme and no germination, respectively. Most (75%) of the seedlings occurred with moderate to heavy stress. Watering every six days, 42 and 58% showed extreme stress or did not germinate, respectively. As with crested wheatgrass, the majority of squirreltail seedlings in coppice soils showed no, slight, or moderate stress, while seedlings in interspace soils occurred with moderate to extreme stress.

IMPACT OF OFF-ROAD VEHICLES ON VESICULAR HORIZONS

At the three off-road vehicle sites (Fig. 1) the impact of a four-wheel drive truck and a motorcycle on vesicular horizons will be evaluated as to vegetation disturbance, wind erosion, sediment production, infiltration rates, and vesicular horizon reformation.

Methods

At each study site the off-road vehicle treatment will be motorcycle single (Fig. 23) and multiple (50) pass (Fig. 24), 4-wheel drive pickup truck single (Fig. 25) and multiple (20) pass (Fig. 26) and control (Fig. 27). Sites will be treated in both spring and late summer of 1975. The treatments

Seedlings in compacted soils showed [illegible] stress, [illegible] while seedlings in [illegible] soils showed [illegible].

Seedlings planted in compacted soil (Fig. [illegible]) [illegible] three days showed the following: [illegible] no stress, [illegible] slight [illegible] moderate stress, [illegible] heavy stress and [illegible] [illegible] seedling stage showed extreme stress. [illegible] every six days (Fig. [illegible]) show [illegible], [illegible], 23, [illegible] and [illegible] showed [illegible] slight, moderate, heavy, extreme, and no germination, respectively.

Seedlings planted in [illegible] soil [illegible] 7, 23, 38, 22, and 10% showed stress of slight, moderate, heavy, extreme, and no germination, respectively. Most ([illegible]) of the seedlings [illegible] moderate to heavy stress. [illegible] extreme stress or did not germinate, respectively. [illegible] groups, the majority of [illegible] seedlings [illegible] slight, or moderate stress, [illegible] moderate to extreme stress.

IMPACT OF OFF-ROAD VEHICLES ON [illegible]

At the three off-road vehicle sites [illegible] wheel drive truck and a motorcycle on [illegible] as to vegetation disturbance, [illegible] tion rates and [illegible].

[illegible]

At each study site the off-road vehicle [illegible] single (1x) [illegible] and multiple [illegible] passes [illegible] truck single (Fig. 25) and multiple [illegible] Sites with [illegible] trampled in [illegible]

Figure 23. Single pass motorcycle treatment.

Figure 24. Multiple pass motorcycle treatment.

Figure 25. Single pass four-wheel drive truck treatment.

Figure 26. Multiple pass four-wheel drive truck treatment.

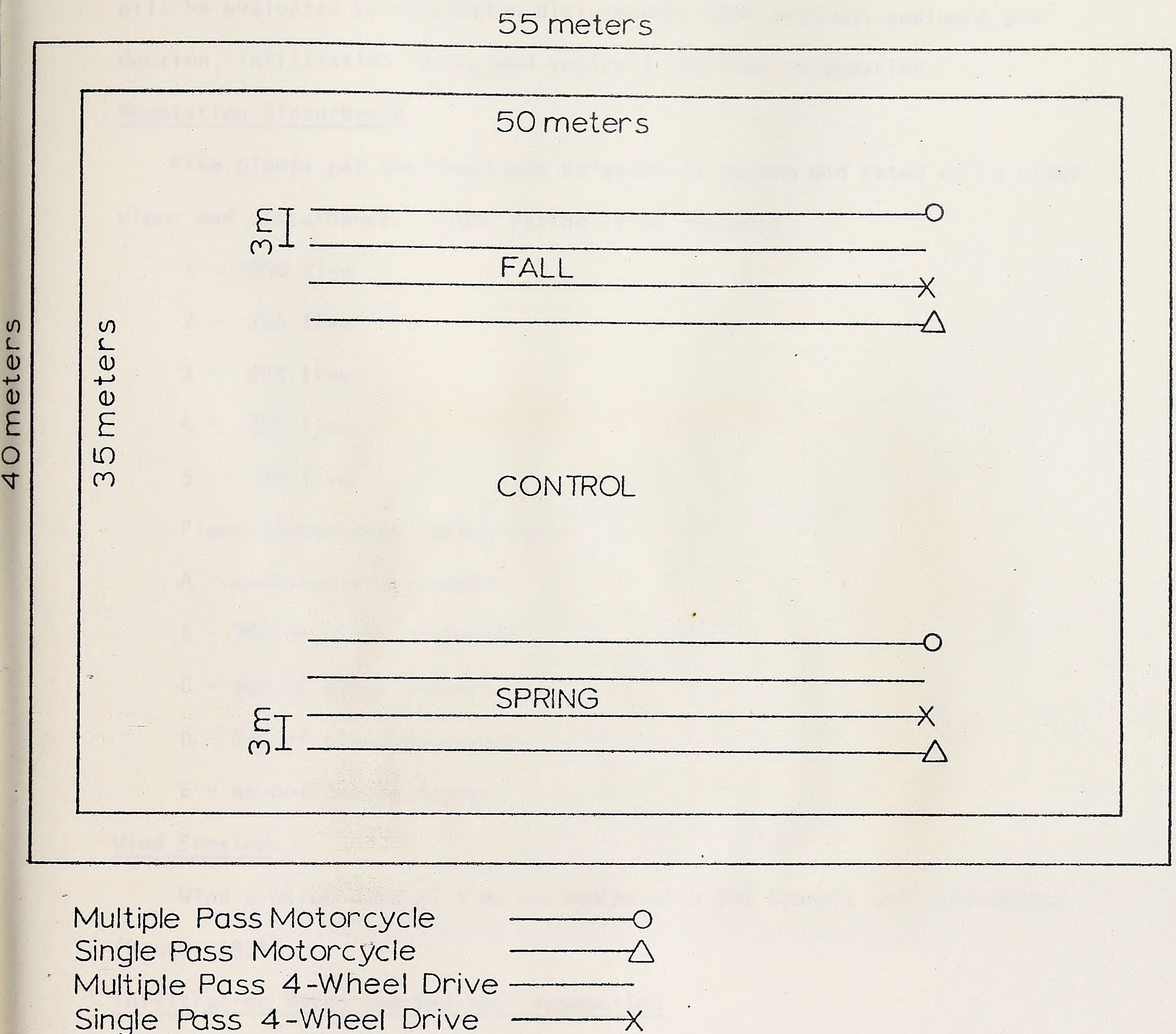


Figure 27. Schematic outline of off-road vehicle treatments.

will be evaluated by vegetation disturbance, wind erosion, sediment production, infiltration rates, and vesicular horizon reformation.

Vegetation Disturbance

Five plants per treatment are selected at random and rated as to plant vigor and disturbance. Vigor rating is as follows:

1 - 100% live

2 - 75% live

3 - 50% live

4 - 25% live

5 - 0% live

Plant disturbance rating is:

A - completely disturbed

B - 75% of plant disturbed

C - 50% of plant disturbed

D - 25% of plant disturbed

E - no noticeable damage

Wind Erosion

Wind erosion data will be collected with the transit and tape method (Booth, 1974).

Infiltration Rates and Sediment Production

An infiltrometer (Blackburn, et al., 1974) will be used to determine treatment impact on infiltration rates and sediment production.

Vesicular Horizon Reformation

Observations of the surface horizon will be made before and after treatment to judge the rate of vesicular horizon reformation.

Results and Discussion

Spring treatments have been made at Crystal Springs and Las Vegas study sites (Figs. 28 and 29). The following is a discussion of those results.

will be evaluated by vegetation disturbance, wind erosion, sediment production, infiltration rates, and vesicular horizon formation.

Vegetation Disturbance

Five plots per treatment are selected at random and rated as to vigor and disturbance. Vigor rating is as follows:

1 = 100% live

2 = 75% live

3 = 50% live

4 = 25% live

5 = 0% live

Disturbance rating is:

1 = completely crushed

2 = 75% of plant disturbed

3 = 50% of plant disturbed

4 = 25% of plant disturbed

5 = no noticeable damage

Wind Erosion

Wind erosion data will be collected with [illegible]

([illegible], 1978).

Infiltration Rates and Sediment Production

An infiltrometer ([illegible] et al., 1978) will be used in each treatment to test the infiltration rates and sediment production.

Vesicular Horizon Formation

Observations of the surface horizon will be made [illegible] treatment to assess the amount of vesicular horizon formation.

Results and Discussion

Earlier treatments have been made at Crystal Springs on [illegible] sites (Figs. 26 and 27). The following is a description of [illegible]

Figure 28. Off-road vehicle treatments being put in at Crystal Springs study site.

Figure 29. Off-road vehicle treatments being put in at Las Vegas study site.

Vegetation Disturbance

Multiple pass motorcycle and truck disturbed along the track about 80% of the vegetation. Single pass motorcycle and single pass truck disturbed 30% and 60% of the vegetation along the track, respectively.

Wind Erosion

Six wind erosion plots were made per treatment. More than one reading is needed on these plots, therefore, this information is not presented in this report.

Infiltration Rates

Seven and one half centimeters of simulated rainfall was applied to the run-off plots. Generally there is a significant (.05 level) lower infiltration rate in interspace areas than in coppice areas regardless of treatment.

Crystal Springs study site- the coppice control infiltration rate was significantly (.05 level) higher than the coppice multiple motorcycle treatment. Interspace control was significantly (.05 level) lower than the multiple motorcycle or multiple truck treatments (Fig. 30). It appears that off-road vehicle disturbance decreases infiltration rates in coppice areas and increases infiltration rates in interspace areas. Infiltration curves are found in Appendix A.

Las Vegas study site - infiltration rate of the coppice control was significantly higher than the multiple motorcycle, multiple truck and single motorcycle treatment on coppice areas. There were no differences in the interspace infiltration rates regardless of treatment (Fig. 31).

Sediment Production

Crystal Spring study site - due to the data variation, there was no significant difference in sediment production between coppice and inter-

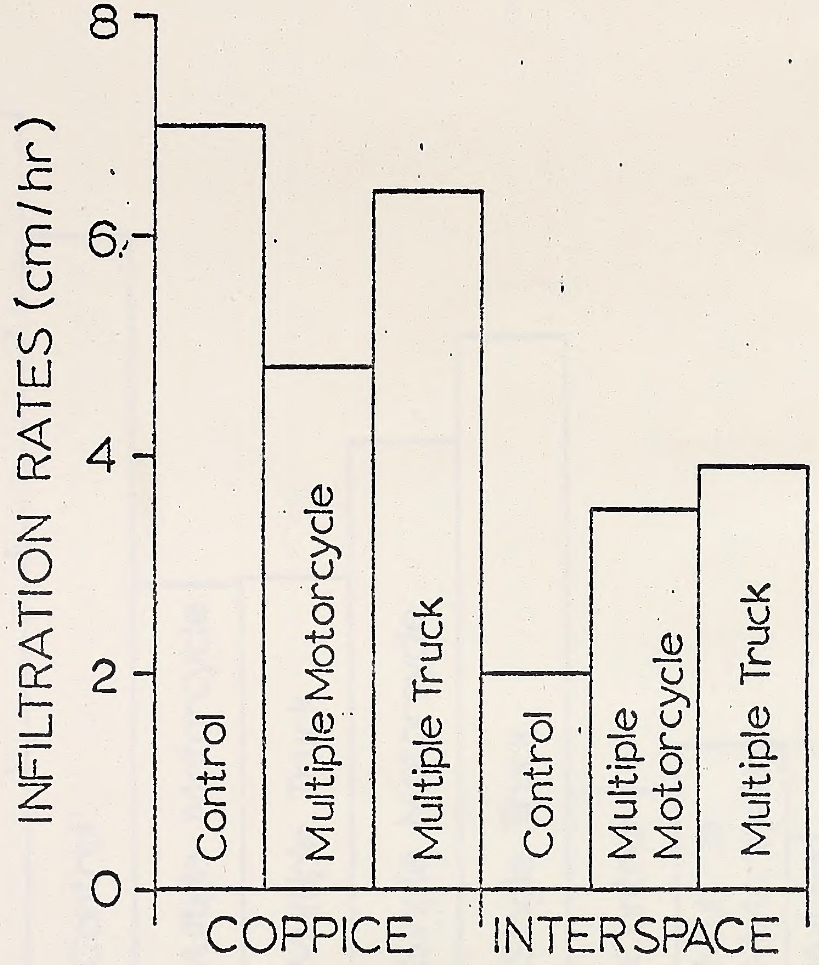


Figure 30. Mean infiltration rate at 30 minutes for the various treatments, Crystal Spring study site. Simulated rainfall 7.5 cm/hr.

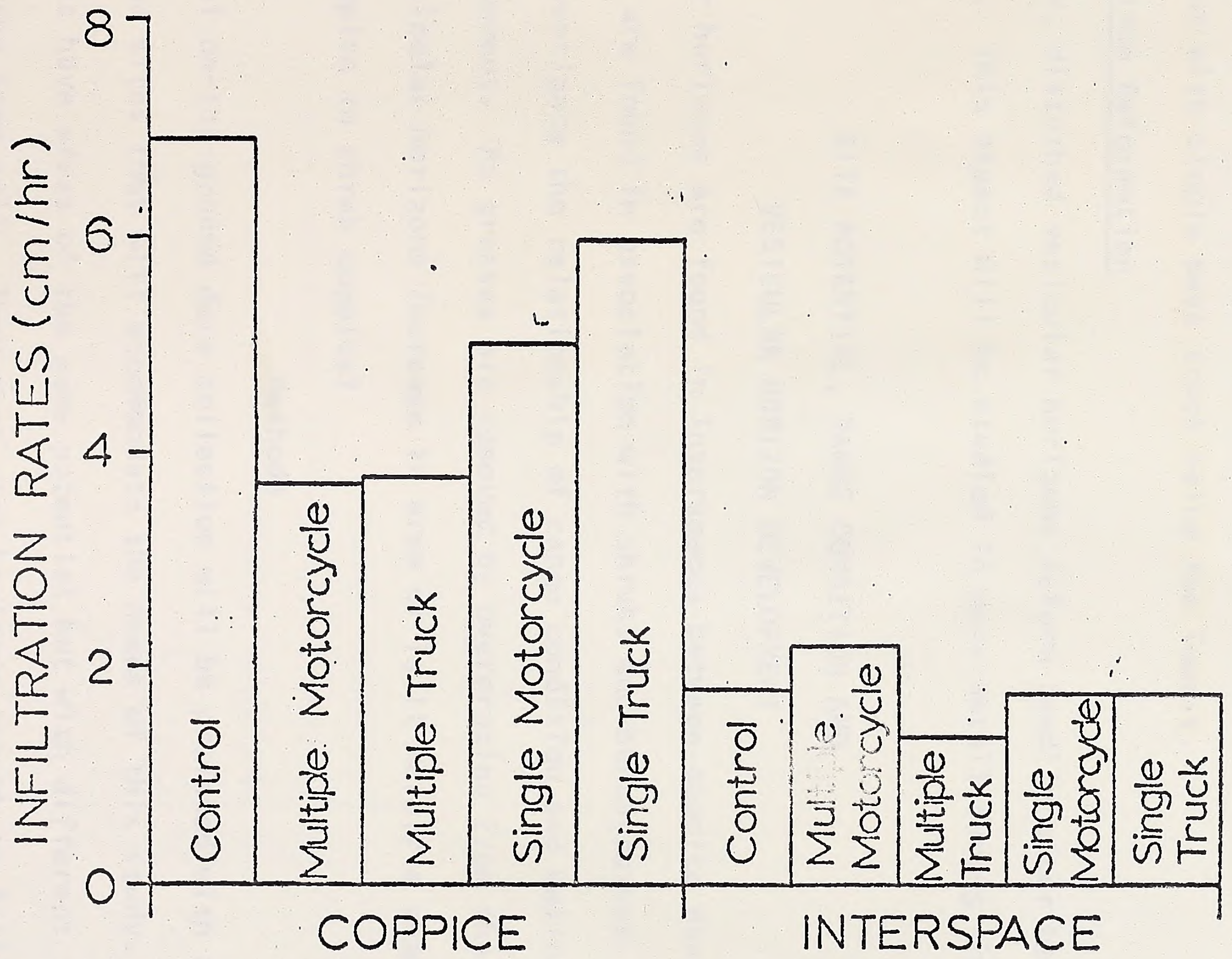


Figure 31. Mean infiltration rate at 30 minutes for the various treatments, Las Vegas study site. Simulated rainfall 7.5 cm/hr.

space areas. Likewise, there was no significant difference among treatment on coppice areas nor on interspace areas (Fig. 32).

Las Vegas study site - generally the sediment production from coppice areas is significantly lower than from interspace (Fig. 33). More sediment production was produced from off-road vehicle treated plots than from control plots. The largest sediment production came from multiple pass truck treatment with single pass truck being the lowest.

Vesicular Horizon Reformation

Generally, disturbed vesicular horizons reform readily after being wet (see page 15). This aspect will be studied in more detail during the next year.

SITE POTENTIAL, RANGE CONDITION AND VESICULAR HORIZON DEVELOPMENT

Vesicular horizons are found in interspaces between coppice dune areas. Coppice dunes are found in association with shrubs and bunchgrasses. This study will investigate the relationship of range condition and vesicular horizon development. As grasses are removed by overgrazing from the interspaces, do vesicular horizons increase in area or is it merely a change from grass coppice to shrub coppice?

Methods

The actual on-the-ground data collection will be prefaced with an intensive search for sites that will accommodate the needs of this study. Each study site must have areas of the same potential but with different range conditions on the same soil. They must also be large enough to facilitate sampling to a ± 10% confidence level. Fence-line contrasts, exclosures, distance to water and relict areas will be used to study the different successional stages (Tueller and Blackburn, 1974).

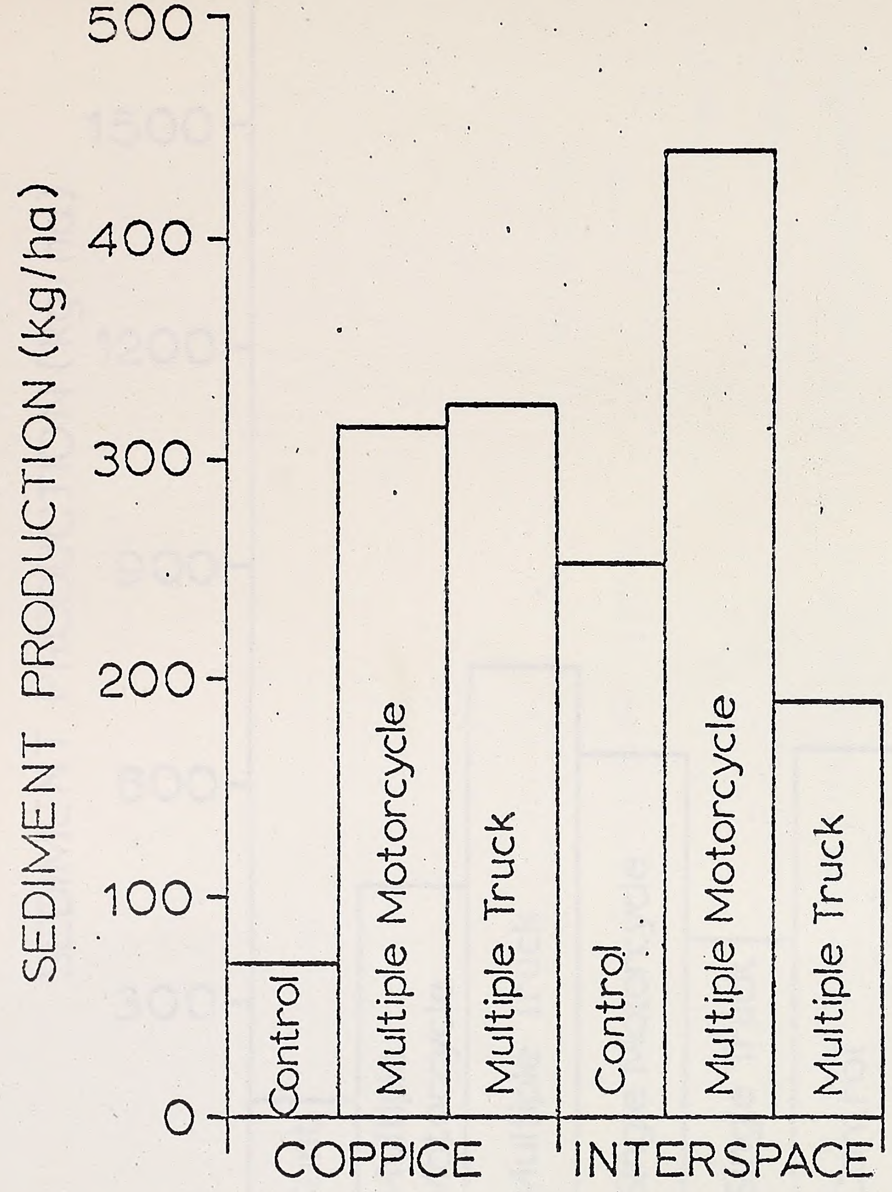


Figure 32. Mean sediment production for the various treatments, Crystal Springs study site. Simulated rainfall 7.5 cm/hr.

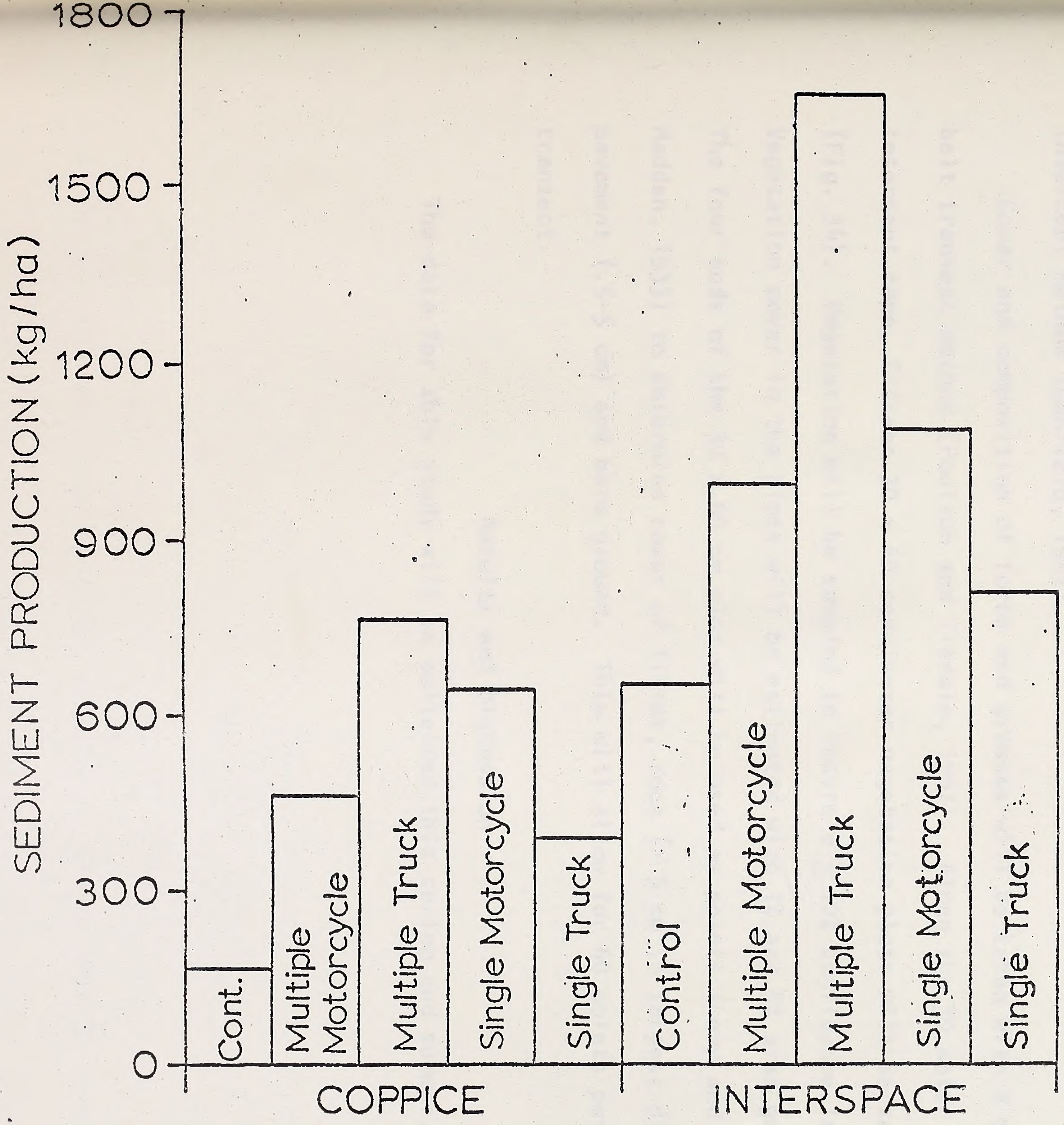


Figure 33. Mean sediment production for the various treatments, Las Vegas study site. Simulated rainfall 7.5 cm/hr.

On each study area soil samples will be taken and tested for certain physical and chemical characteristics (Black, et al., Ed., 1965).

1. Aggregates
2. Particle-size analysis
3. Organic matter

Coppice dune and dune interspace cover will be measured by the line-intercept method (Canfield, 1941).

Cover and composition of forbs and grasses will be taken with a modified belt transect method (Poulton and Tisdale, 1961). Along the 30 meter line-intercept tape, fifteen 30 x 60 centimeter vegetation plots will be sampled (Fig. 34). Vegetation will be sampled to insure a $\pm$ 10% confidence level. Vegetation cover in the plots will be estimated with 1% and 5% area guides. The four ends of the 30 x 60 cm plot will be used as points (Levy and Madden, 1933) to determine cover of litter, rock (> 5 cm in largest dimensions), pavement (.5-5 cm) and bare ground. This will allow for 60 points per transect.

Results and Discussion

The data for this study will be collected this spring and summer.

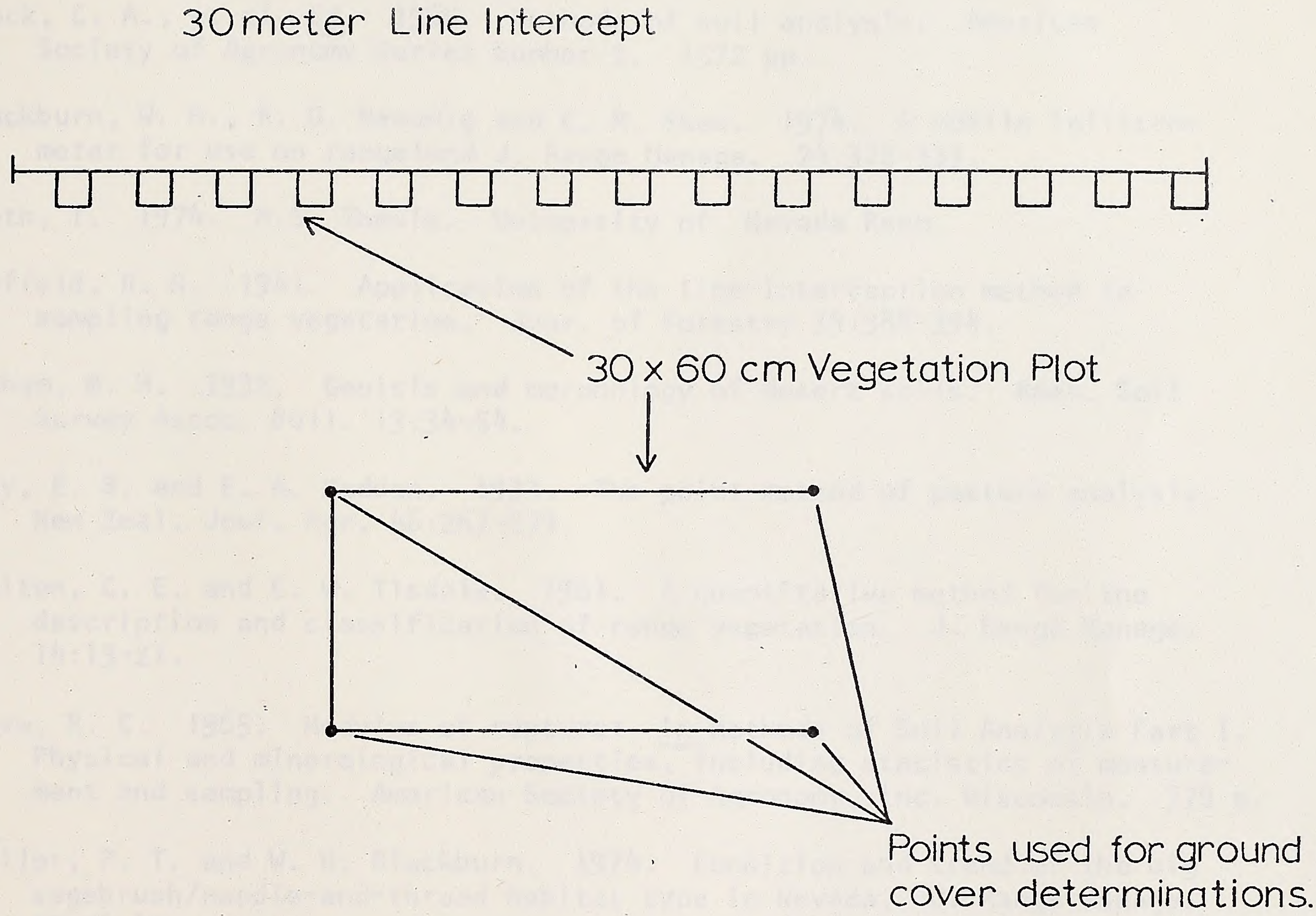


Figure 34. Schematic drawing of the line-intercept and 30 x 60 cm plot.

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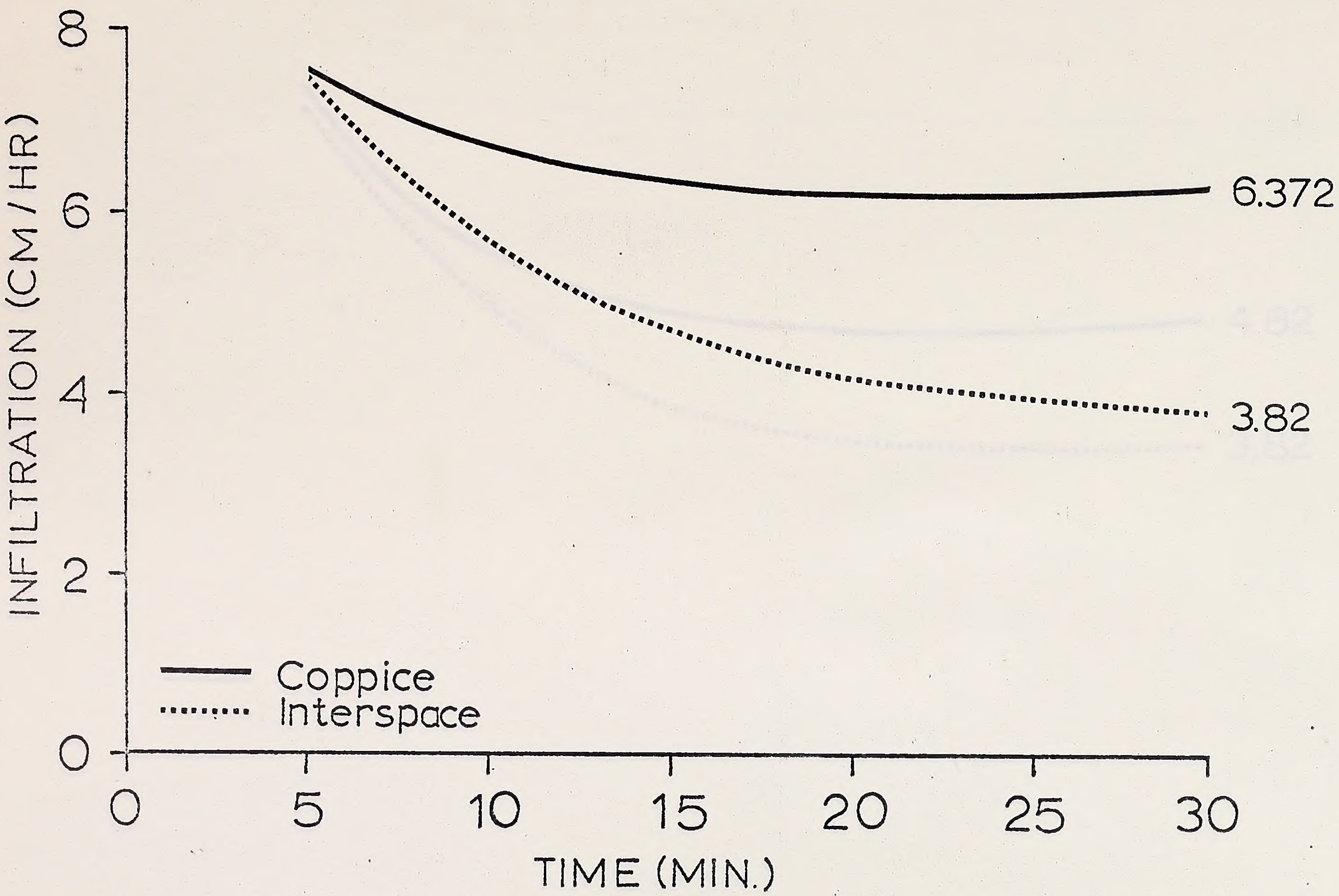
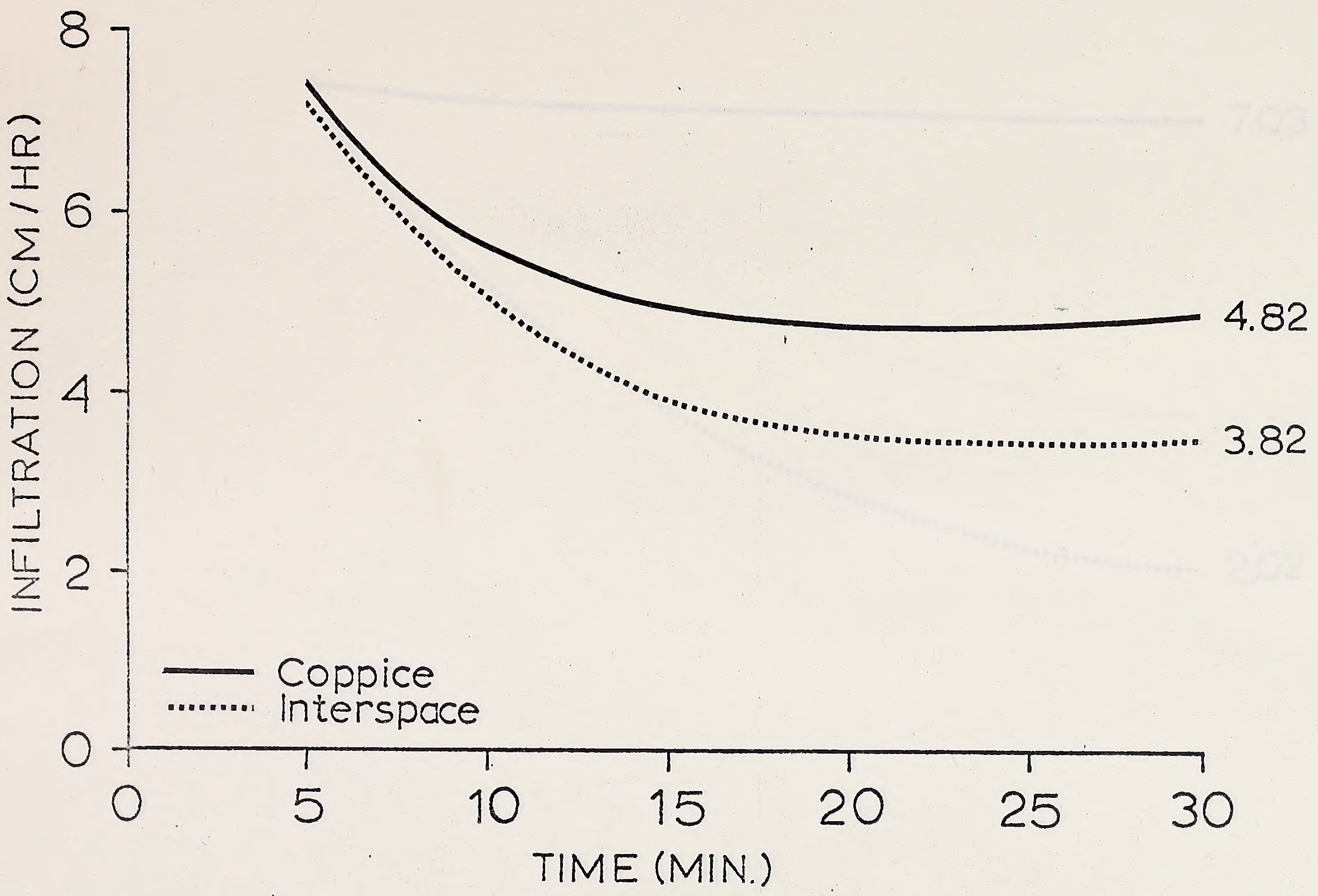
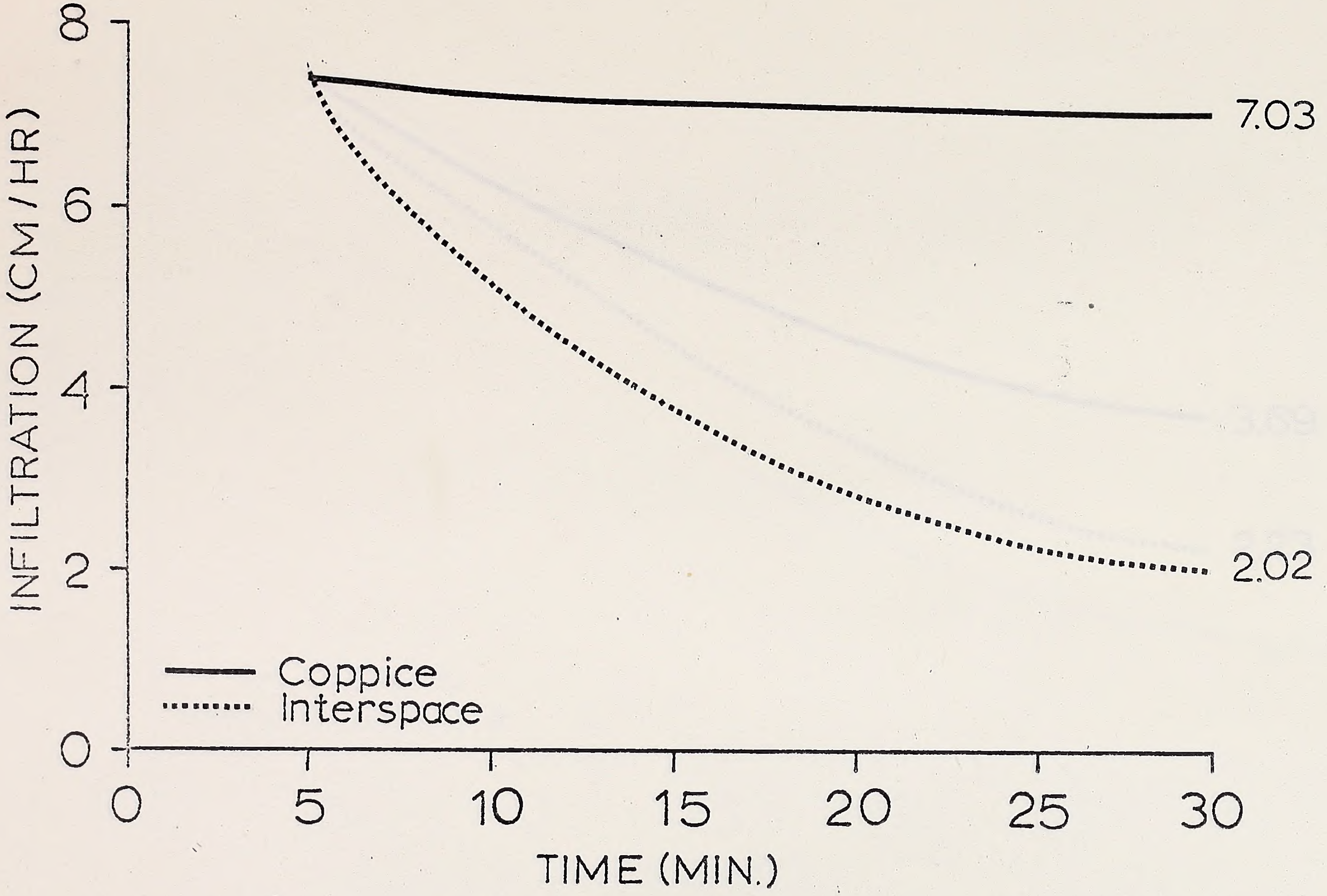
APPENDIX A. Infiltration curves for off-road vehicle treatments, Crystal Springs and Las Vegas study sites. Simulated rainfall applied at 7.5 cm/hr.



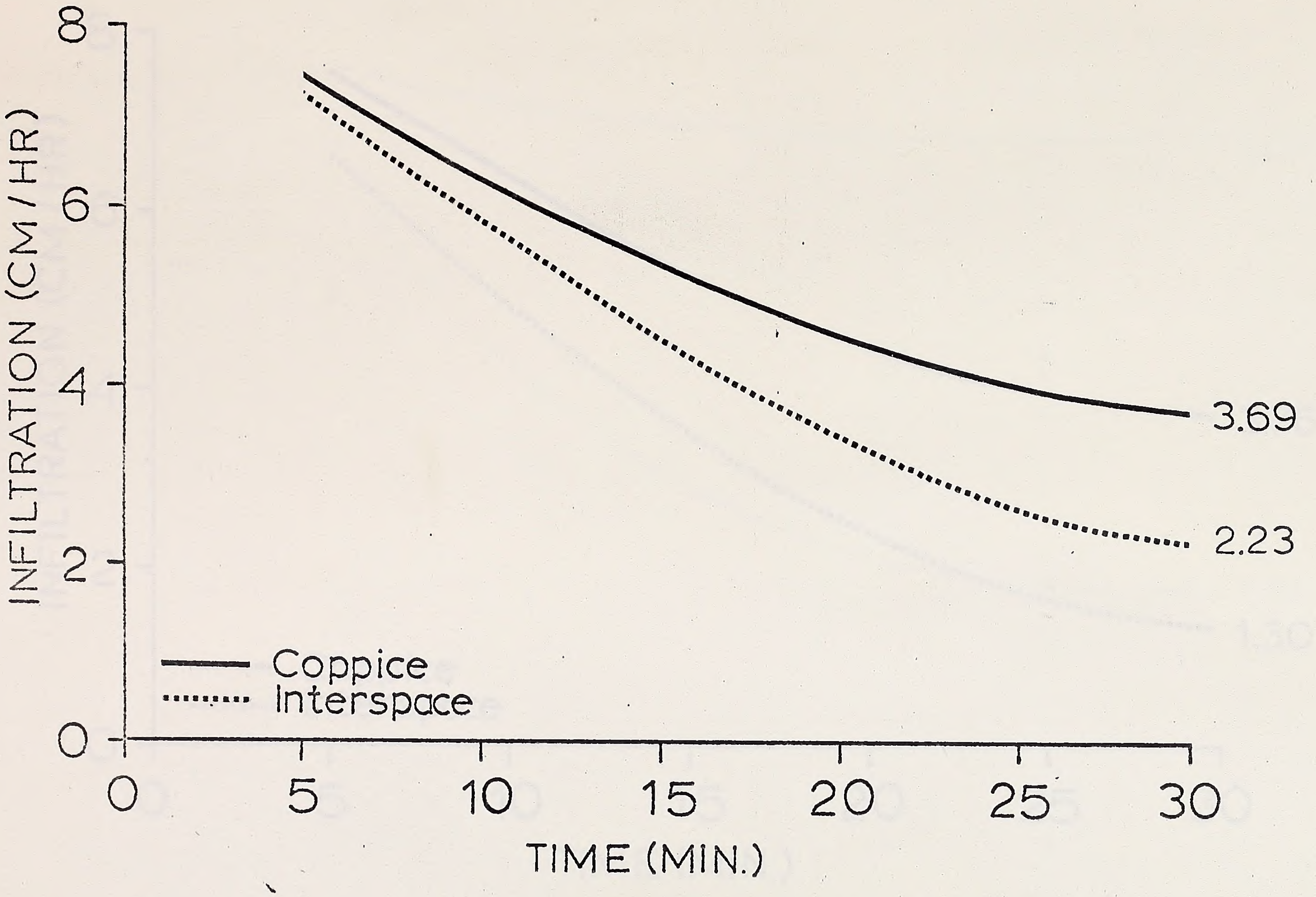
Number 1. Infiltration curves for multiple pass four-wheel drive truck treatment, Crystal Springs study site.



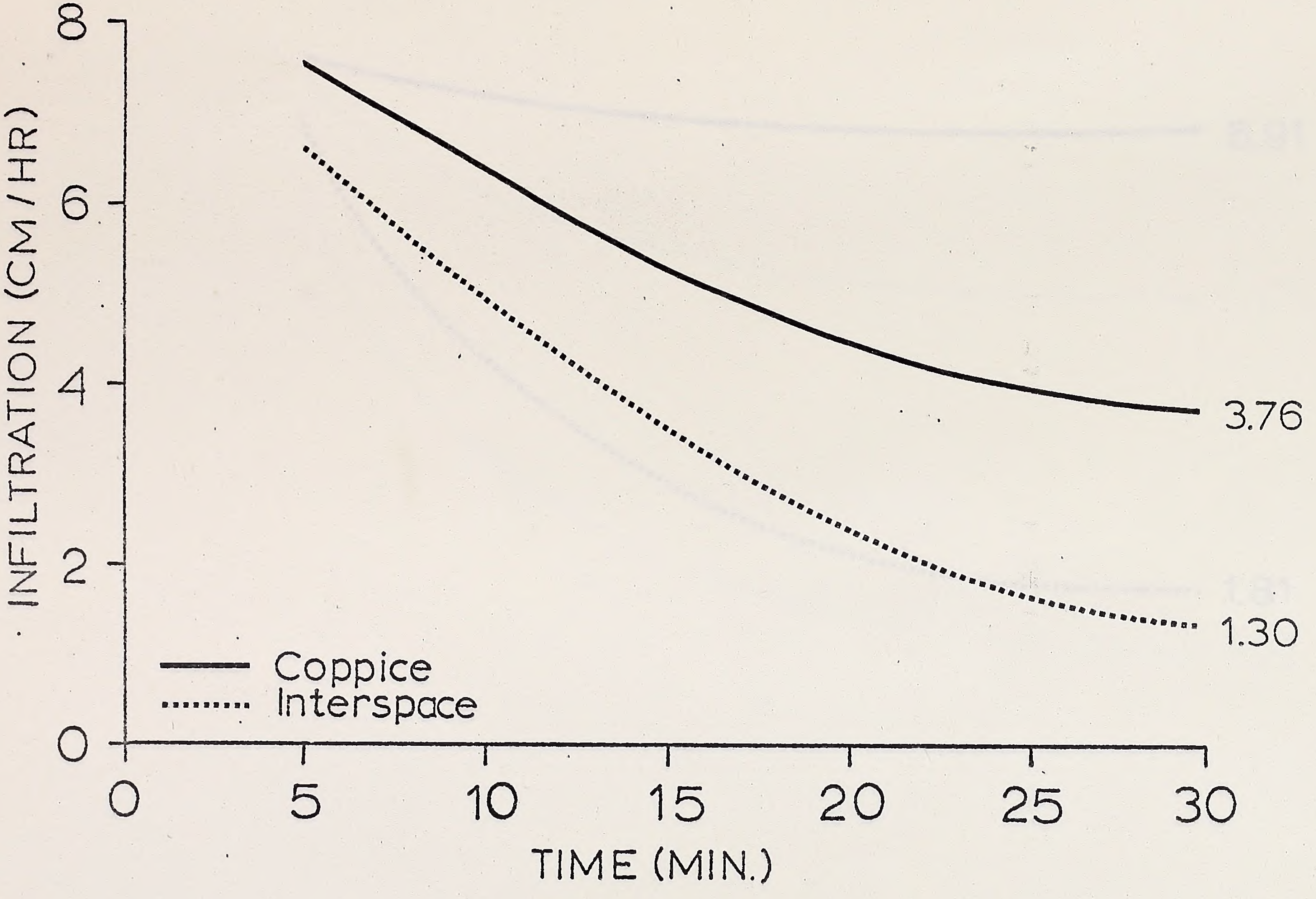
Number 2. Infiltration curves for multiple pass motorcycle treatment, Crystal Springs study site.



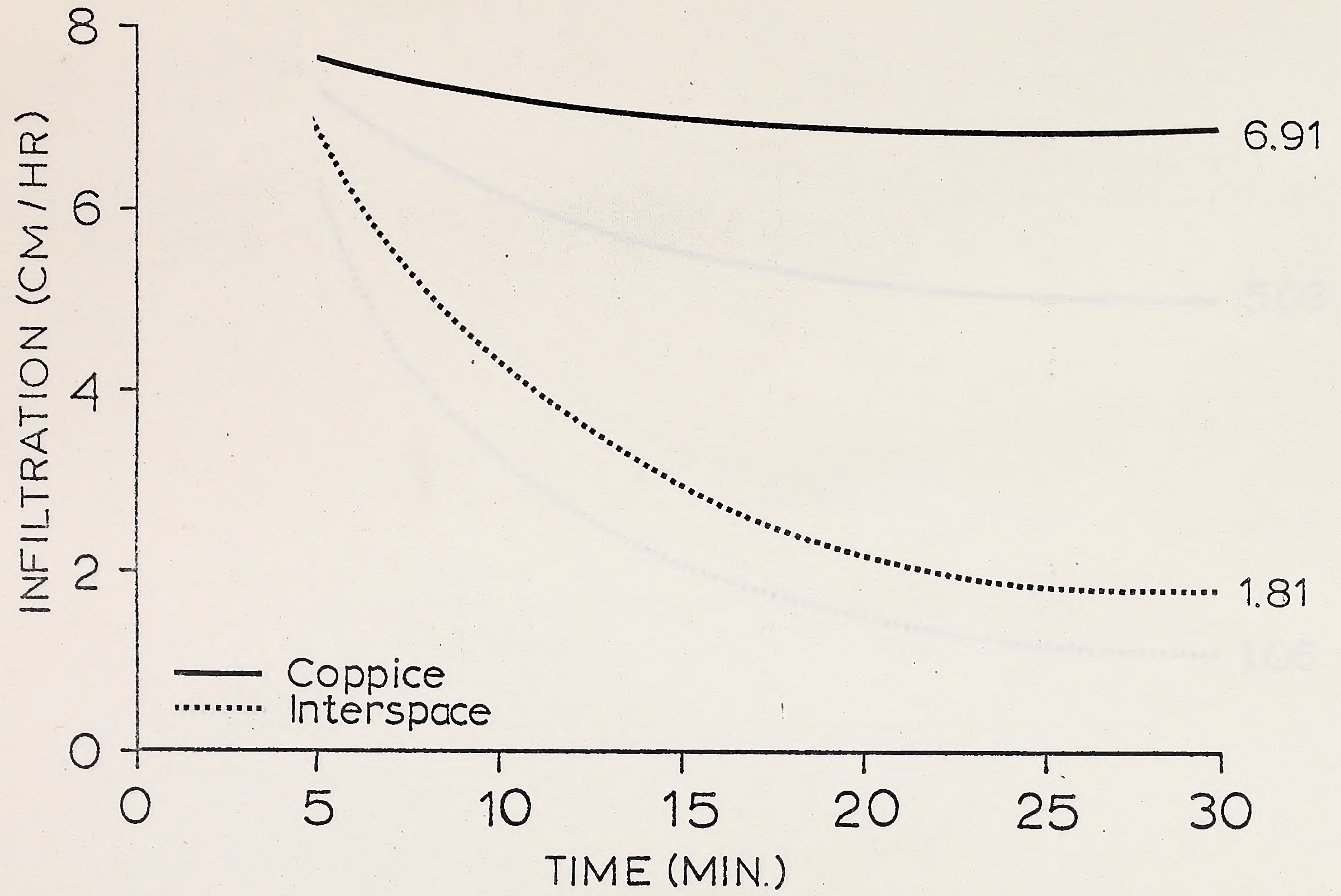
Number 3. Infiltration curves for control plots, Crystal Springs study site.



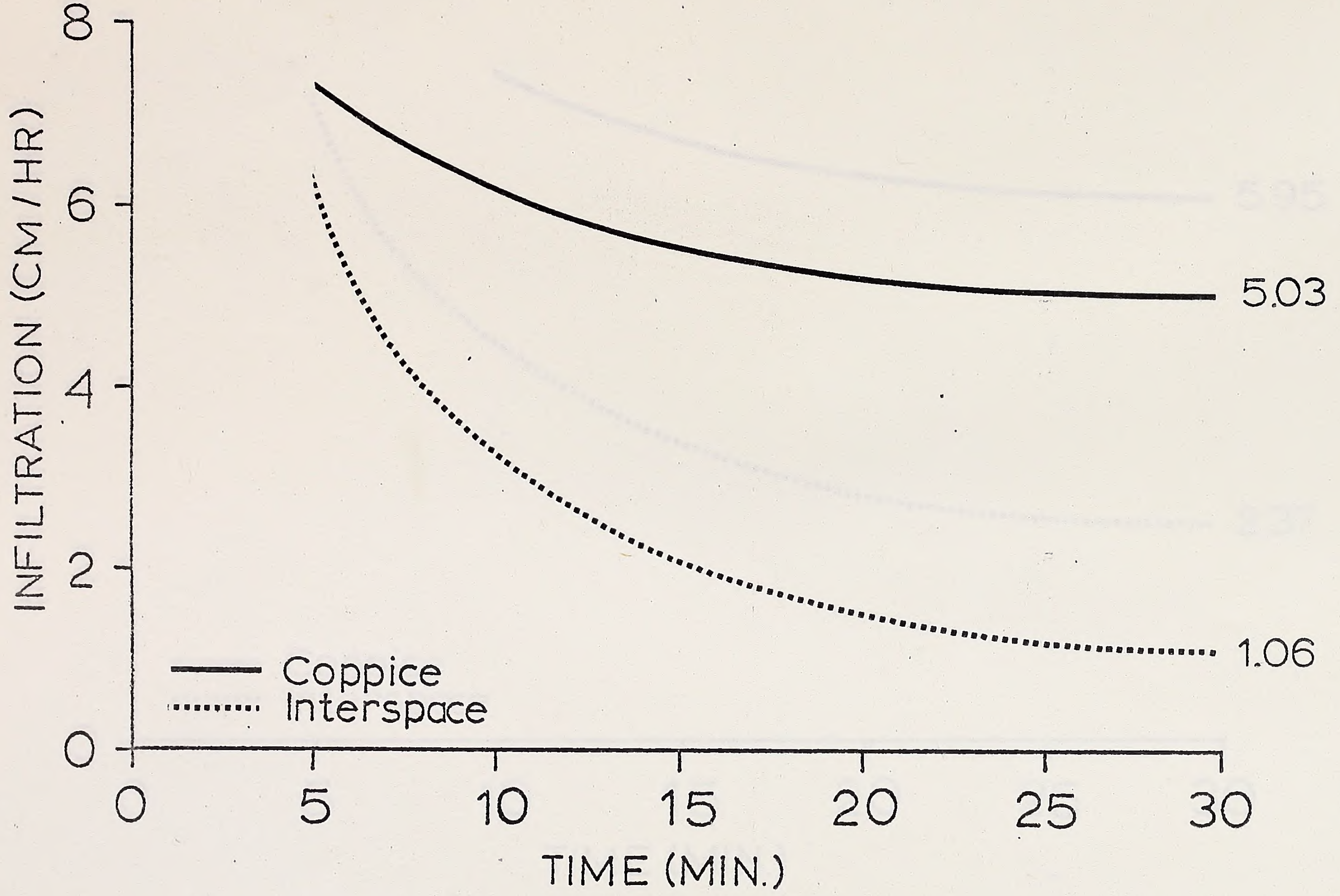
Number 4. Infiltration curves for multiple pass motorcycle treatment, Las Vegas study site.



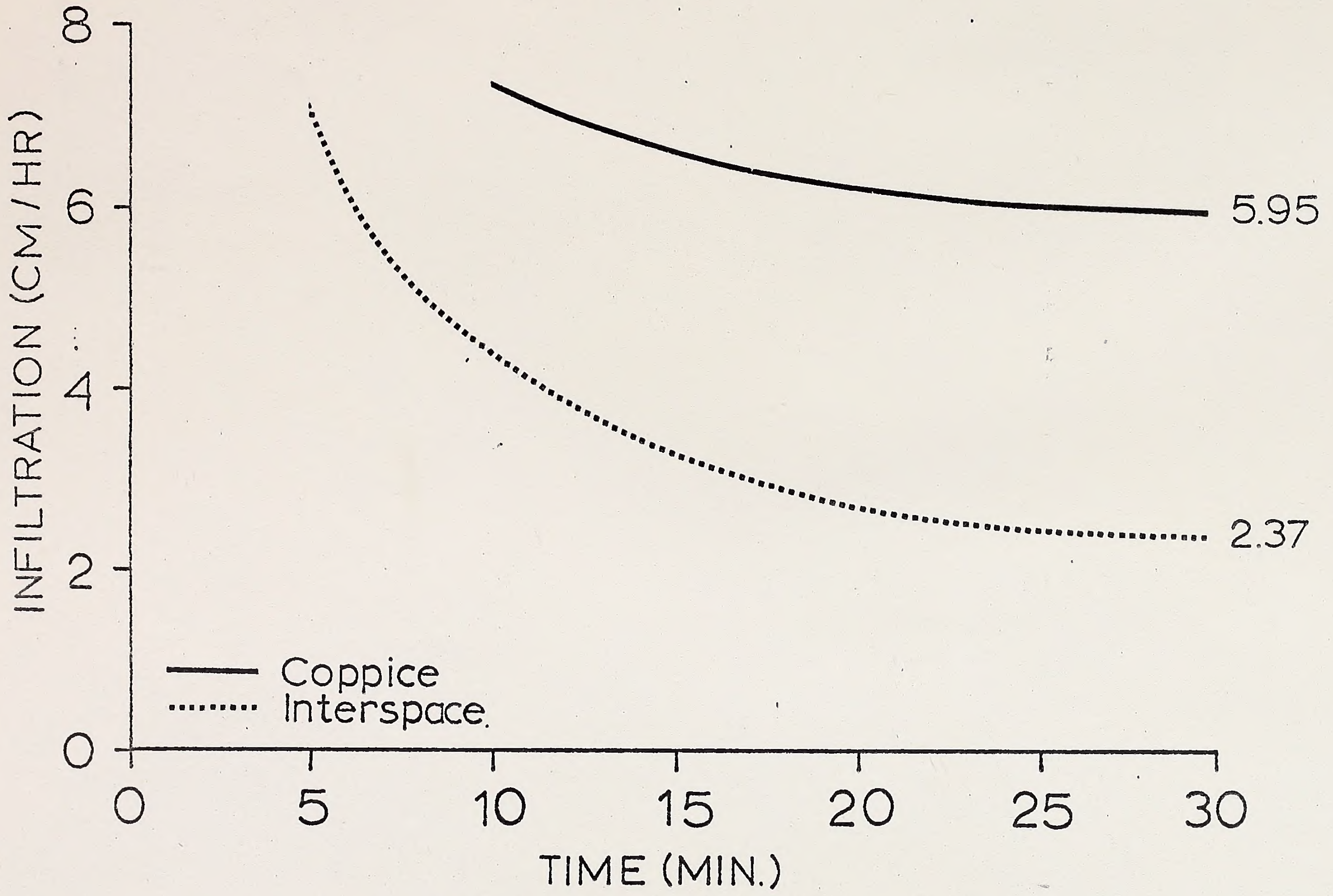
Number 5. Infiltration curves for multiple pass four-wheel drive truck treatment, Las Vegas study site.



Number 6. Infiltration curves for control plots, Las Vegas study site.



Number 7. Infiltration curves for single pass motorcycle treatment, Las Vegas study site.



Number 8. Infiltration curves for single pass four-wheel drive truck, Las Vegas study site.